

Figure 1

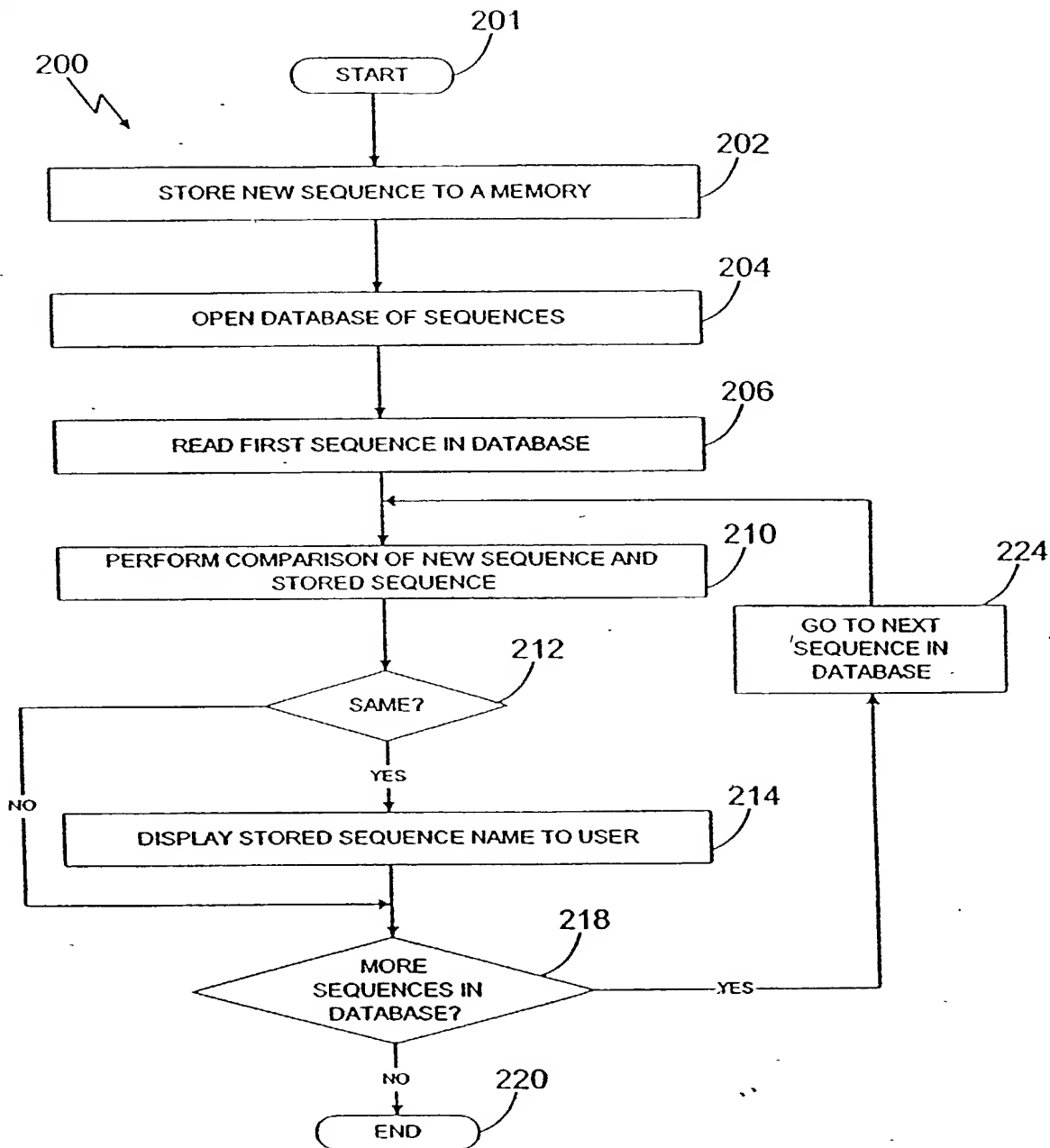


Figure 2

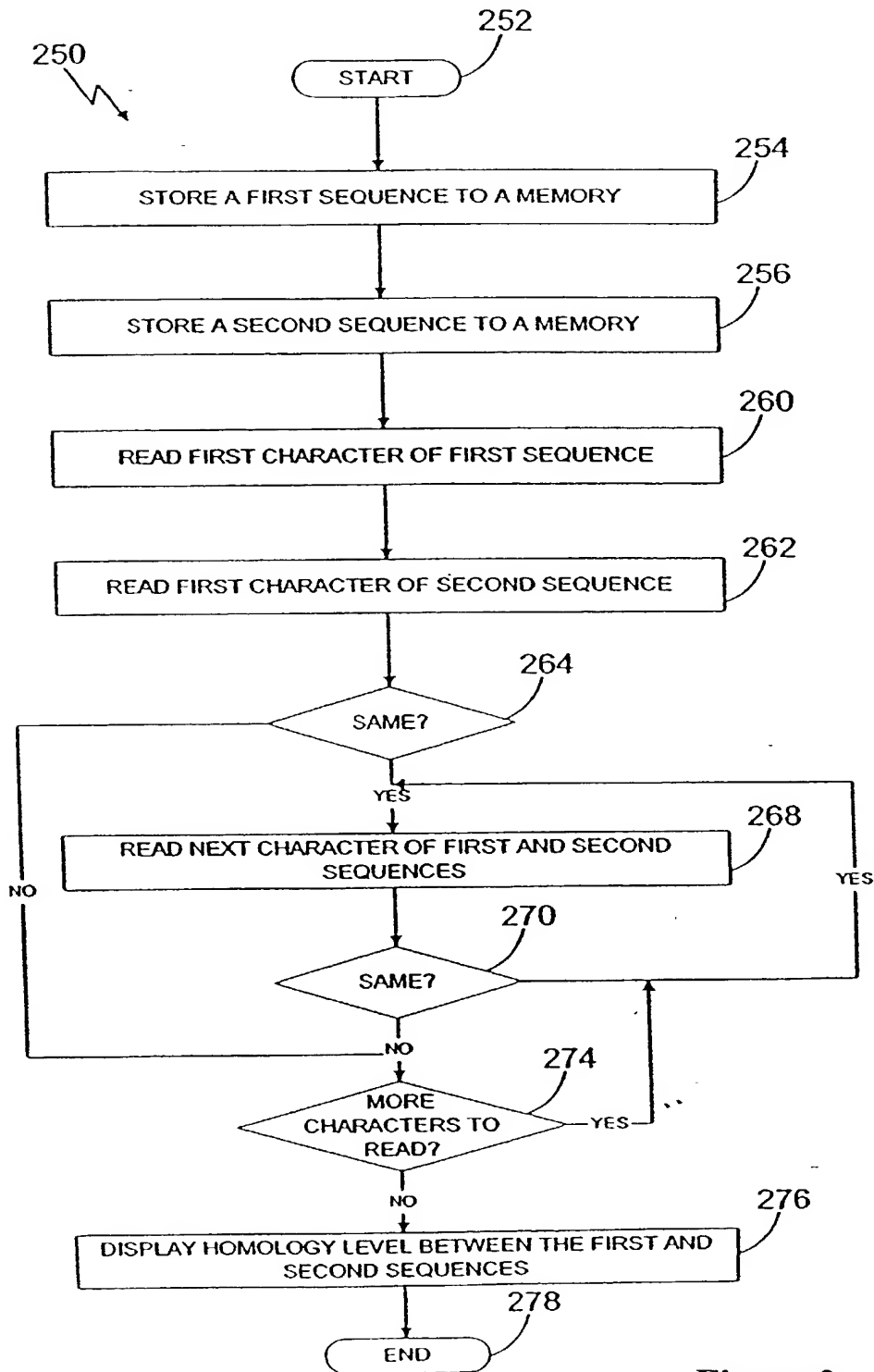


Figure 3

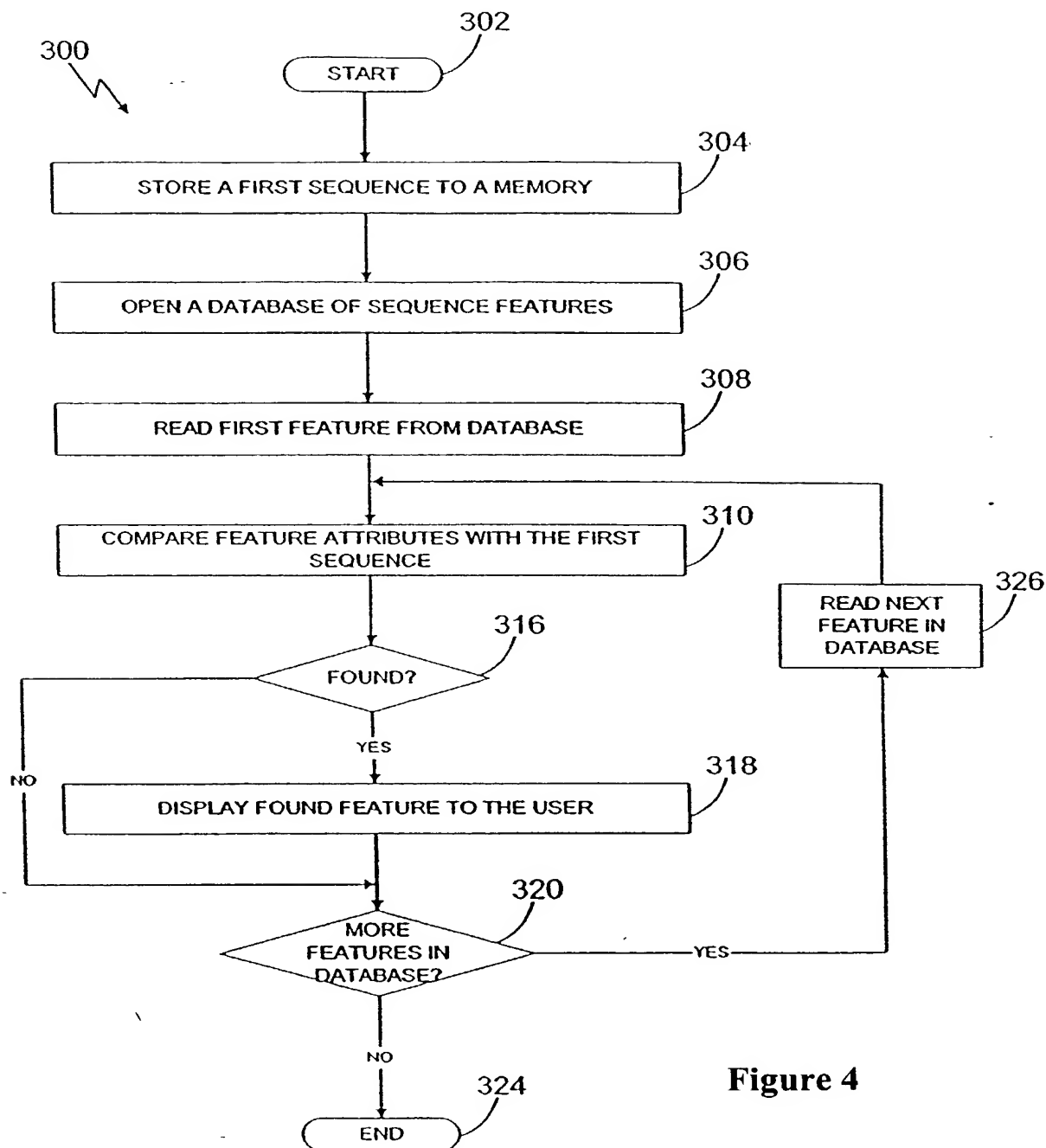
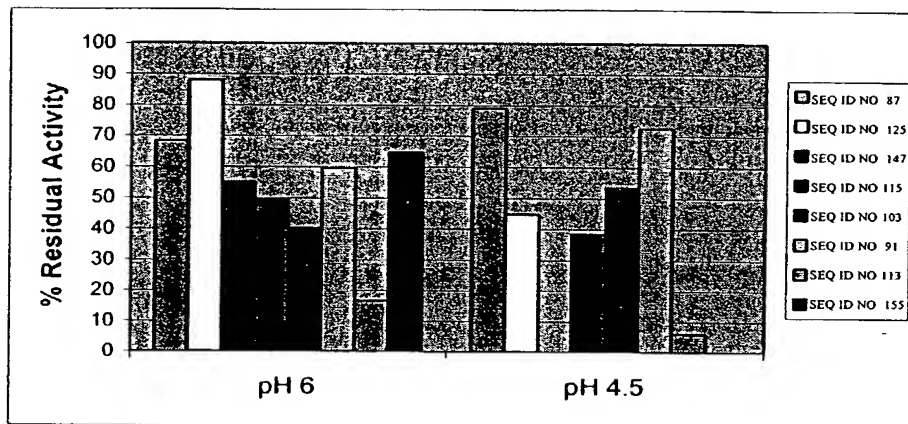
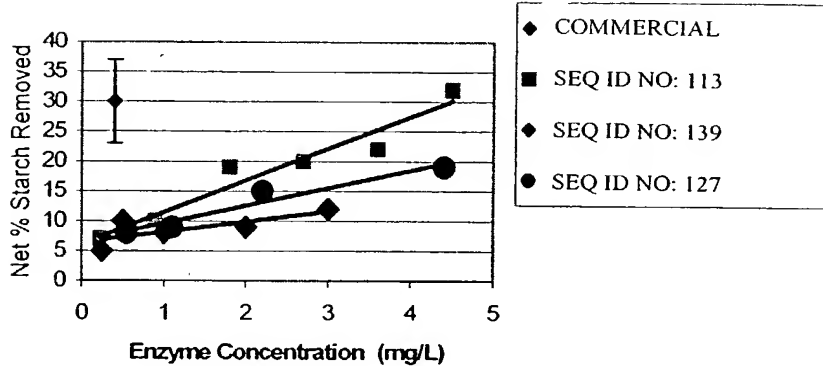


Figure 4

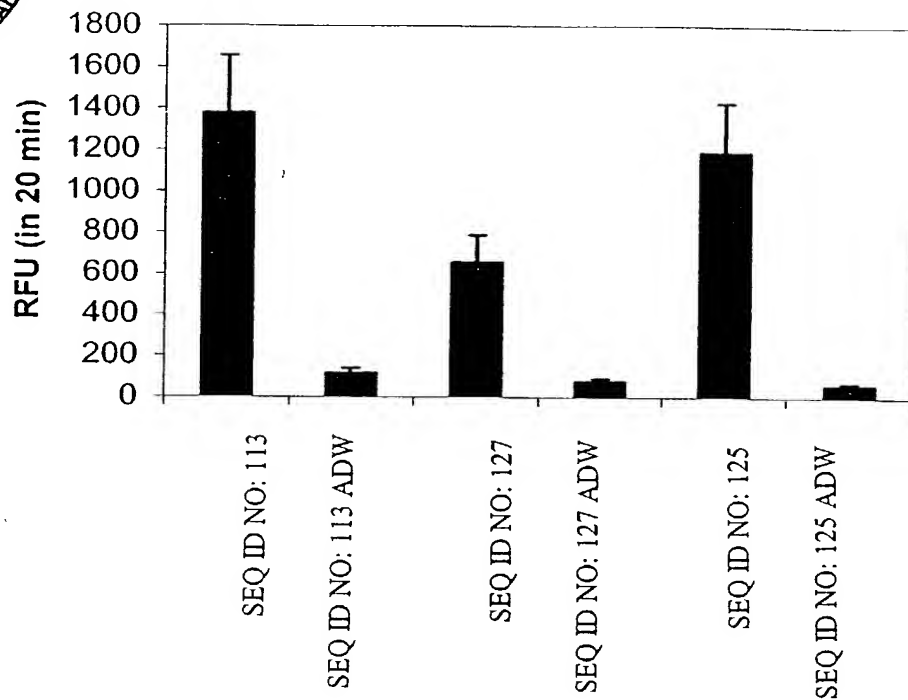


**Figure 5:** Residual activity of various amylases following heating to 90°C for 10 min.



**Figure 6.** Net percent starch removed vs. enzyme concentration in ADW wash test with bleach and chelators

**Figure 7:** Activity of parental amylases at pH 8, 40°C (black bars) in ADW formulation at 25°C (gray bars). Values are the average of 384 wells with error bars representing the standard deviation.



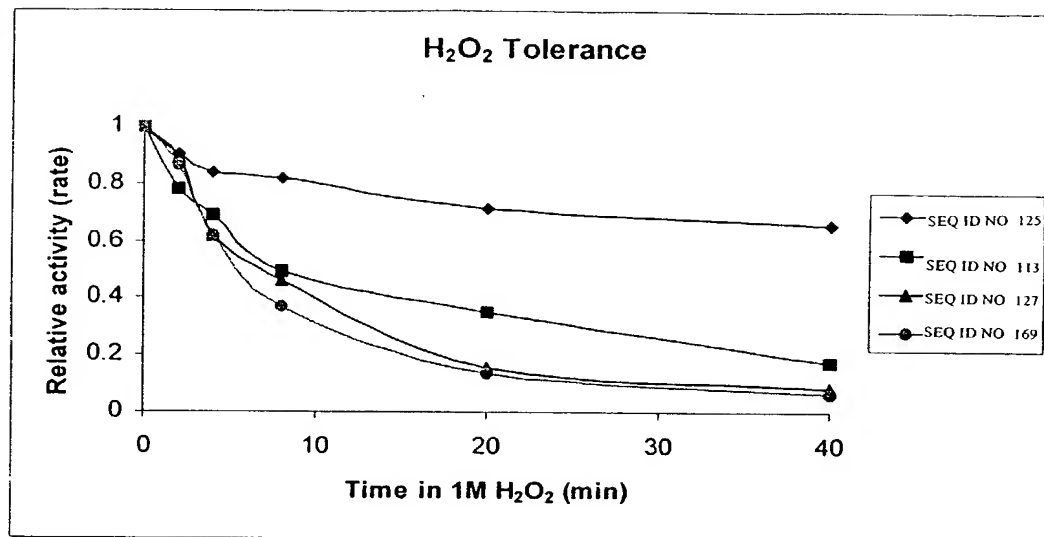
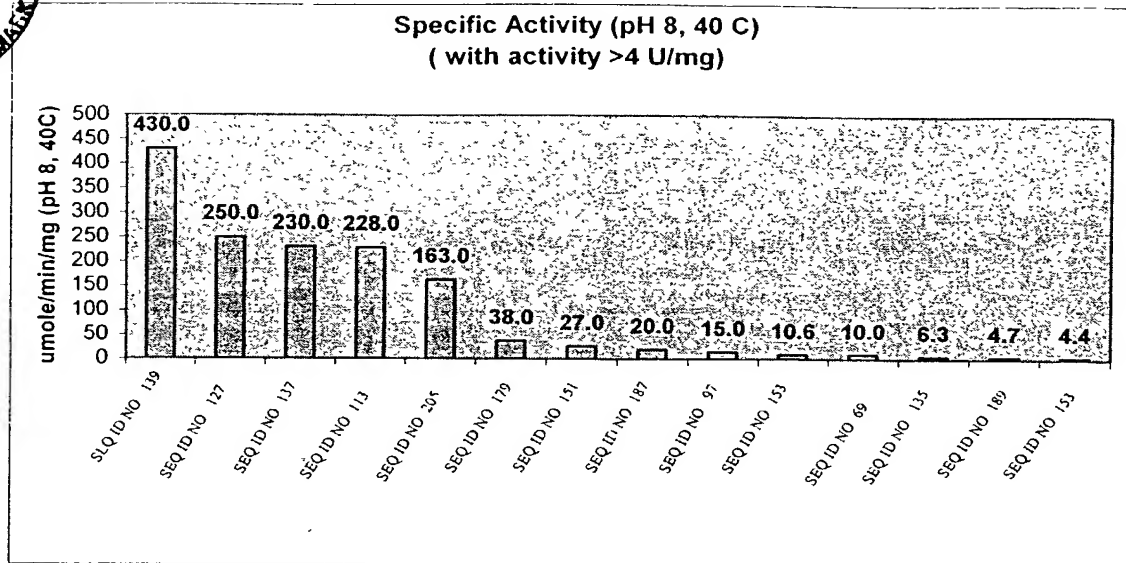
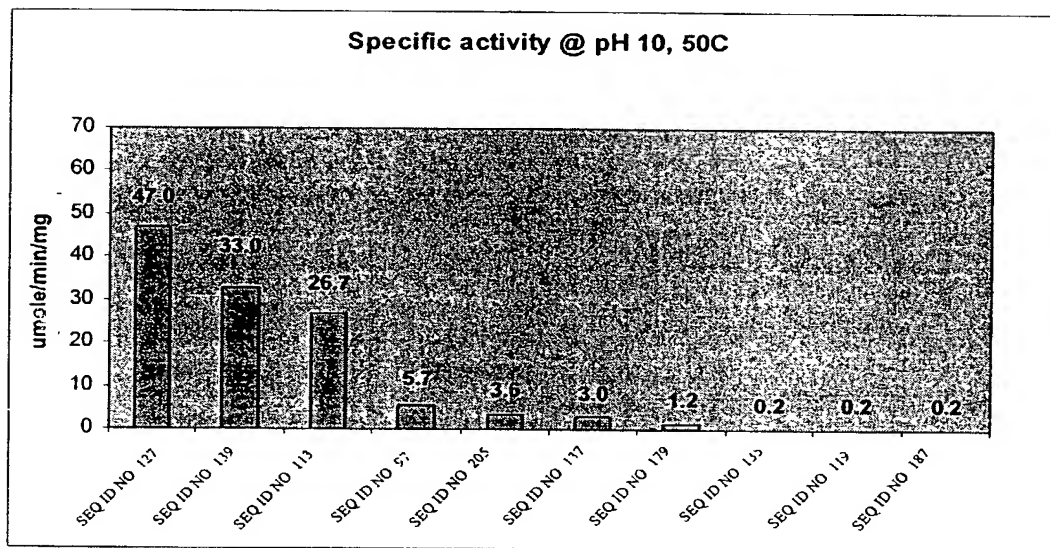


Figure 8



**Figure 9A**



**Figure 9B**



Figure 10: Alignments of the genes proposed to be used in reassembly

```

1
SEQ ID NO:114 (AA 29-512) (1) -----AANLNGTLMQYFEWYMPNDGQHWKREQND SAYLAEHGITAVWIPPAYKGTG--QADVGYGAYDLYDLGEFHQKGTVR 80
SEQ ID NO:128 (AA 31-615) (1) -QANTAPVNGTMMQYFEWDLNDGTLWTWKVNEASSLSGLGITALWLPAYKGTG--QGDVGYGWYDLYDLGEFHQKGTIR
SEQ ID NO:116 (AA 2-437) (1) AKYSELEQGGVIMQAFYWDVPEGGIWDWTIRQKIP EWYDAGISAIWIPFASKMGGAYSMGYDPDYDFDLGEFYQKGTVE

81
SEQ ID NO:114 (76) TKYGTGKELQSAIFSLHSRDINVGDDVINHKGGADATEDVTAVEVDPACRNRHVISGEHRKAWTHFHFPGRGSTYSDFK 160
SEQ ID NO:128 (79) TKYGTGKTYLQAIQAASAGHQVYADVFNHKGAGADSTEWDAVEVNPSPNRNQETSQTYQIQAWTKFDFPGRGNTYSSEK
SEQ ID NO:116 (81) TRFGSKKEELVNMESTAHGYGIRKVIADIVINERAGGDLEWNPYVGDTWTDFSKVASGKYKAHYMDFIPN-----

161
SEQ ID NO:114 (156) WHWYHFDGTDWDESRLNRIYKFG--KAWDWEVSNENGNYDILMYADIDYDHPDVAAEIKRWGTWYANELQLDGFRLLDA 240
SEQ ID NO:128 (159) WRWYHFDGTDWDESRLNRIYKFRGTGKAWDWEVDTEGNYDILMYADLMDHPVVTELKNWGTWYVNTTVDGFRLLDA
SEQ ID NO:116 (150) ----NYSTSGEGTFGGFPDIDELVPFNQYWLWASNES-----YAYLRSIGIDAWRFDY

241
SEQ ID NO:114 (234) VVHIKESFLRDWYNHVREKTGKEMFTVAEYWNNDLGALENYLNKTNFNHSHVFDVPLHYQFHAASTQGGGYDMRKLLNG-- 320
SEQ ID NO:128 (239) VVHIKYSFFPDNLTHVRSQTRKNLFAVGEFWSYDVNKEHNYITKTSGTMSLEFADPLHNNFYTASKSSGYFDMRYLLNN--
SEQ ID NO:116 (200) VVGYGAWVVKDNLSSQWGG-----WAVGEYWDCTNVDALLNWAYSSG--AKVFDFPLLYKMDFAFNKNIPALVYAIQNGE

321
SEQ ID NO:114 (312) TVVSKHPLKAVIFMDNHDTPGQSLESTVCTWFKPLAYAFETITRESGYEQVFGDLMYGTGKDSQ--REIPALKHKHIEPTL 400
SEQ ID NO:128 (317) TLMKDOBLSLAVTLVDNHDTPGQSLQSWEPWFKPLAYAFETITRCEGYHCVEYGEHYGIPKYN----IPGLKSKIDPLL
SEQ ID NO:116 (272) TVVSRDEPKAVTFVANHDN-----IIWNKYPAYAFETITYE--QGVLEFYRDEEWNKND-----KLNNL---I

401
SEQ ID NO:114 (390) KARKQYAYGAQHDFDHHDIVGWTREGDSSVANSGLAALITDGPGGAKRMYVGRONAGETWHDITGNRS--EPVVINSEG 480
SEQ ID NO:128 (392) IARRDYAYGTORDYIDHODIIGWTREGIDSKPNSGLAALITDGPGGSKWMYVQKKHAGKVFEYDITGNRS--DTVTINADG
SEQ ID NO:116 (331) WIHEHLAGGSTRIILYDDDELIEMREGYGERPGL-ITYINLGSDWAEERWNVGSKFAGYTIHEYTGNLGGWVDRYVQYDG

481
SEQ ID NO:114 (468) WGEFHVN-----GGSVSIYVQR----- 560
SEQ ID NO:128 (470) WGEFKVN-----GGSVSIYVAKTSQVTFVNNATTISGQNVYVVCNIPELGNWNTANAIKMTPSSSYPTWKATIALP
SEQ ID NO:116 (410) WVKLTAPPHDPFANGYGYGYSYWSYAGVG-----

561
SEQ ID NO:114 (485) ----- 605
SEQ ID NO:128 (541) QGKAIEFKFIKKDQSGNVVWESI PNRTYTVFPLSTGSYTASWNP
SEQ ID NO:116 (437) -----
```

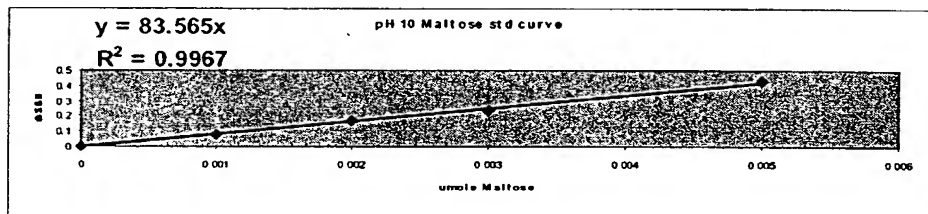


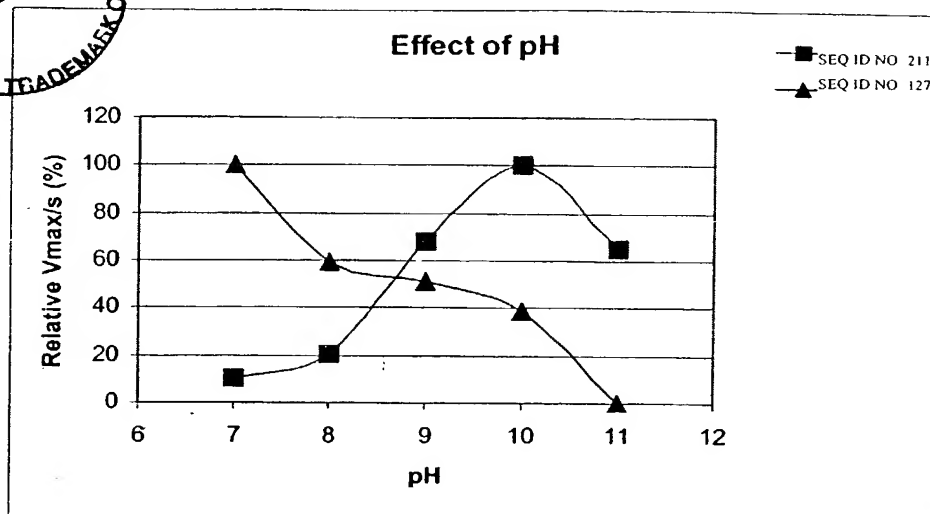
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ENZYMES HAVING ALPHA AMYLASE ACTIVITY AND  
METHODS OF USE THEREOF

**Figure 11:** Example Standard Curve of the assay of Example 5.





**Figure 12:** A graph of the pH rate profiles for 2 different amylases. BD7188 is a control; an enzyme that was discovered previously and has a neutral pH optimum. BD7837 is a more recently discovered amylase and has an optimum around pH 10. Pure protein was used in these assays.

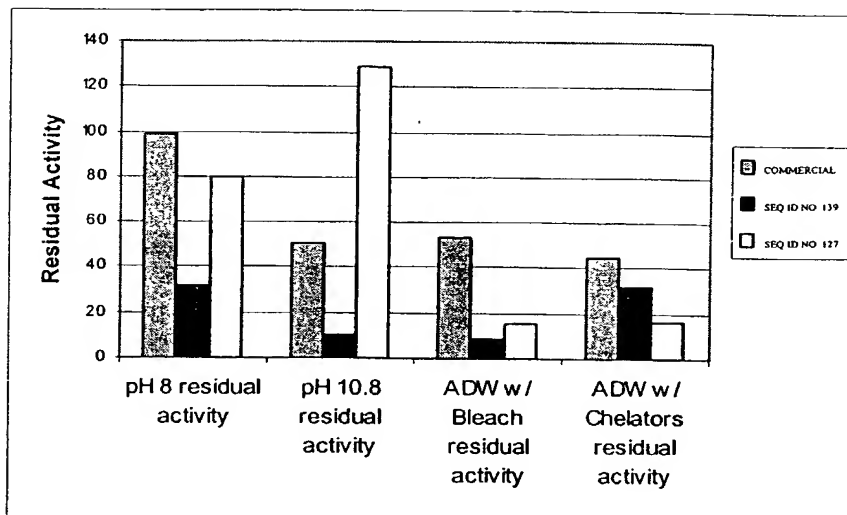


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METHODS OF USE THEREOF



**Figure 13:** Stability of Diversa amylases vs. a commercial enzyme



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ENZYMES HAVING ALPHA AMYLASE ACTIVITY AND  
METHODS OF USE THEREOF

SEQ ID NO 82  
pyro (SEQ ID NO:313)  
pyro2 (SEQ ID NO 314)  
thermo (SEQ ID NO 315)  
thermo2 (SEQ ID NO 316)  
Consensus (SEQ ID NO 317)

```
1
-----MKK FVALFITMFF VVSMVV... .AQPASAAK
-----MKK FVALLITMFF VVSMVAV... .AQPASAAK
-----VNIKK LTPLLTLLLF FI...VL... .ASPVSAAK
SESQCTATCT WRVVYMSAKK LLALLFVLAV LVGVAVIPAR VGIAPVSAGA
-----MA RKVLVALLVF LVVLSVSAVP
-----SA--
```

SEQ ID NO 82  
pyro (SEQ ID NO 313)  
pyro2 (SEQ ID NO:314)  
thermo (SEQ ID NO:315)  
thermo2 (SEQ ID NO 316)  
Consensus (SEQ ID NO 317)

```
51
YS..ELEEGG VIMQAFYWDV PGGGIWWDTI RSKIPEWYEA GISAIWIPPA
YS..ELEEGG VIMQAFYWDV PAGGIWWDTI RSKIPEWYEA GISAIWIPPA
YL..ELEEGG VIMQAFYWDV PGGGIWWDHI RSKIPEWYEA GISAIWLPPP
TSRPSLEEGG VIMQAFYWDV PAGGIWWDTI RSKIPDWA SA GISAIWIPPA
AKAETLENGG VIMQAFYWDV PGGGIWWDTI AQKIPDWA SA GISAIWIPPA
-----LE-GG VIMQAFYWDV P-GGIWWD-I --KIP-W--A GISAIW-PP-
Sense primer
```

SEQ ID NO 82  
pyro (SEQ ID NO:313)  
pyro2 (SEQ ID NO 314)  
thermo (SEQ ID NO 315)  
thermo2 (SEQ ID NO:316)  
Consensus (SEQ ID NO 317)

```
101
SKGMSGGYSM GYDPYDFFDL GEYNQKGTIE TRFGSKQELI NMINTAHAYG
SKMGGAYSM GYDPYDFFDL GEYNQKGTVE TRFGSKQELI NMINTAHAYG
SKGMSGGYSM GYDPYDYFDL GEYYQKGTVE TRFGSKEELV RLIQTAHAYG
SKGMSGAYSM GYDPYDFFDL GEYYQKGTVE TRFGSKQELI NMINTAHSYG
SKGMSGGYSM GYDPYDFFDL GEYYQKGSVE TRFGSKEELV NMINTAHAHN
SKGM-G-YSM GYDPYD-FDL GEY-QKG--E TRFGSK-EL--I-TAH---
```

SEQ ID NO:82  
pyro (SEQ ID NO 313)  
pyro2 (SEQ ID NO:314)  
thermo (SEQ ID NO 315)  
thermo2 (SEQ ID NO:316)  
Consensus (SEQ ID NO:317)

```
151
IKVIADIVIN HRAGGDLEWN PFVGDYTD WTD FSKVASGKYT ANYLDFHPNE
IKVIADIVIN HRAGGDLEWN PFVGDYTD WTD FSKVASGKYT ANYLDFHPNE
IKVIADVVIN HRAGGDLEWN PFVGDYTD WTD FSKVASGKYT ANYLDFHPNE
IKVIADIVIN HRAGGDLEWN PFTNSYTD WTD FSKVASGKYT ANYLDFHPNE
MKVIADIVIN HRAGGDLEWN PFTNSYTD WTD FSKVASGKYT ANYLDFHPNE
-KVIAD-VIN HRAGGDLEWN PF---YTD WTD FSKVASGKYT ANYLDFHPNE
```

SEQ ID NO:82  
pyro (SEQ ID NO:313)  
pyro2 (SEQ ID NO 314)  
thermo (SEQ ID NO:315)  
thermo2 (SEQ ID NO:316)  
Consensus (SEQ ID NO:317)

```
201
VKCCDEGTFG GFDPDIAHEKS WDQHWLWASD ESYAAYLR SI GVDARWFDYV
VKCCDEGTFG GFDPDIAHEKE WDQHWLWASD ESYAAYLR SI GVDARWFDYV
LHCCDEGTFG GFDPDICHHEKE WDQYWLWASN ESYAAYLR SI GFDGWRFDYV
VKCCDEGTFG GFDPDIAHEKS WDQYWLWASQ KSYAAYLR SI GIDARWFDYV
LHAGDSGTFG GYPDICHDKS WDQHWLWASN ESYAAYLR SI GIDARWFDYV
----D-GTFG G-PDI-H-K- WDQ-WLW-S- -SYAAYLR SI G-D-WRFDYV
```

SEQ ID NO:82  
pyro (SEQ ID NO:313)  
pyro2 (SEQ ID NO 314)  
thermo (SEQ ID NO:315)  
thermo2 (SEQ ID NO:316)  
Consensus (SEQ ID NO:317)

```
251
KGYGAWVVKD WLNWWGGWAV GEYWDTN VDA LLNWAYSSGA KVFDFPLYK
KGYGAWVVKD WLNWWGGWAV GEYWDTN VDA LLNWAYSSGA KVFDFPLYK
KGYGAWVVRD WLNWWGGWAV GEYWDTN VDA LLSWAYESGA KVFDFPLYK
KGYGAWVVKD WLKWW-ALAV GEYWDTN VDA LLNWAYSSGA KVFDFPLYK
KGYAPWVVKD WLNRRWGGWAV GEYWDTN VDA LLSWAYDSGA KVFDFPLYK
KGY--WVV--WL--W--AV GEYWDTN VDA LL-WAY-SGA KVFDFPLYK
```

SEQ ID NO:82  
pyro (SEQ ID NO:313)  
pyro2 (SEQ ID NO:314)  
thermo (SEQ ID NO:315)  
thermo2 (SEQ ID NO:316)  
Consensus (SEQ ID NO 317)

```
301
MDEAFDNKNI PALVSA LQNG QTVVSRD PFK AVTFVANHDT DIIWNKYLA Y
MDEAFDNTNI PALVDA LQNG GTVVSRD PFK AVTFVANHDT DIIWNKYPA Y
MDEAFDNNNI PALVYA LQNG QTVVSRD PFK AVTFVANHDT DIIWNKYPA Y
MDEAFDNKNI PALVSA LQNG QTVVSRD PFK AVTFVANHDT DIIWNKYPA Y
MDEAFDNNNI PALVDA LKNG GTVVSRD PFK AVTFVANHDT DIIWNKYPA Y
MDEAFDN-NI PALV-A L-NG -TVVSRD PFK AVTFVANHDT -IIWNKY-A Y
```

Figure 14A-1



SEQ ID NO 82  
pyro (SEQ ID NO 313)  
pyro2 (SEQ ID NO 314)  
thermo (SEQ ID NO 315)  
thermo2 (SEQ ID NO 316)  
Consensus (SEQ ID NO 317)

```
351                                     400
AFILTYEGQP VIFYRDYEEW LNKDRLN NLI WIHDHLAGGS TSIVYYDSDE
AFILTYEGQP VIFYRDYEEW LNKDKLN NLI WIHDHLAGGS TSIVYYDSDE
AFILTYEGQP VIFYRDFEEW LNKDKLINLI WIHDHLAGGS TTIVYYDNDE
AFILTYEGQP VIFYRDYEEW LNKDRLKNLI WIHNNLAGGS TSIVYYDNDE
AFILTYEGQP AIFYRDYEEW LNKDRLR NLI WIHDHLAGGS TDIIYYDSDE
AFILTYEGQP -IFYRD -EEW LNKD-L- NLI WIH--LAGGS T-I-YYD-DE
```

SEQ ID NO 82  
pyro (SEQ ID NO 313)  
pyro2 (SEQ ID NO 314)  
thermo (SEQ ID NO 315)  
thermo2 (SEQ ID NO 316)  
Consensus (SEQ ID NO 317)

```
401                                     450
MIFVRNGYGS KPGLITYINL GSSKVGR WVY VPKFAGAC IH EYTGNLGGWV
LIFVRNGDSK RPGLITYINL GSSKVGR WVY VPKFAGAC IH EYTGNLGGWV
LIFVRNGDSR RPGLITYINL SPNWWGR WVY VPKFAGAC IH EYTGNLGGWV
LIFVRNGYGN KPGLITYINL GSSKVGR WVY VPKFAGSC IH EYTGNLGGWV
LIFVRNGYGD KPGLITYINL GSSKAGR WVY VPKFAGSC IH EYTGNLGGW I
-I FVR NG--- -PGLITYINL -----GR WVY VPKFAG-C IH EYTGNLGGW -
```

SEQ ID NO 82  
pyro (SEQ ID NO 313)  
pyro2 (SEQ ID NO 314)  
thermo (SEQ ID NO 315)  
thermo2 (SEQ ID NO 316)  
Consensus (SEQ ID NO 317)

```
451                                     486
DKYVY SSGWV YFEAPAYDPA NGQYGYS VWS YCGVG*
DKYVE SSGWV YLEAPAYDPA SGQYGYT VWS YCGVG*
DKRVD SSGWV YLEAPP HDPA NGYYGYS VWS YCGVG*
DKYVG SNGWV YLEAPAH DPA KGQYGYS VWS YCGVG*
DKWVD SSGRV YLEAPAH DPA NGQYGYS VWS YCGVG*
DK-V- S-G-V Y-EAP- -DPA -G-YGY- VWS YCGVG*
```

Anti sense primer

Figure 14A-2



	1				50
SEQ ID NO:82	-----	-----	-----	MKK FVA	LFITMFFV VS MAVVAQPASA
pyro (SEQ ID NO:313)	-----	-----	-----	MKK FVA	LLITMFFV VS MAAVAQPASA
SEQ ID NO:74	-----	-----	-----	-----	-----
thermo2 (SEQ ID NO:316)	-----	-----	-----	MA	RKVLVALL VF LVVLSVSAVP
SEQ ID NO:76	-----	-----	-----	-----	-----
SEQ ID NO:78	-----	-----	-----	-----	-----
SEQ ID NO:84	-----	-----	-----	-----	-----
SEQ ID NO:86	-----	-----	-----	-----	-----
SEQ ID NO:80	-----	-----	-----	-----	-----
thermo (SEQ ID NO:315)	-----	-----	-----	MKP AKL	LVFVLVVS IL AGLYAPGAGA
pyro2 (SEQ ID NO:314)	SESQC TATCT	WRVVYM SAKK	LLALLFV LAV	LVGVAVIPAR	VGIAPVVSAGA
CLONE A (SEQ ID NO:318)	-----	-----	-----	VN IKK	LTPLLTLL LF FIVLASPVSA
Consensus (SEQ ID NO:319)	-----	-----	-----	MRRS ARV	LVLIIAFFLL AGIYYPSTSA
	51				100
SEQ ID NO:82	AKYSE LEEGG	VIMQAF YWDV	PGGGIWWDTI	RSKIPEWY EA	GISAIWIPPA
pyro (SEQ ID NO:313)	AKYSE LEEGG	VIMQAF YWDV	PAGGIWWDTI	RSKIPEWY EA	GISAIWIPPA
SEQ ID NO:74	---MA LEEGG	LIMQAF YWDV	PGGGIWWDTI	AQKIPDWA SA	GISAIWIPPA
thermo2 (SEQ ID NO:316)	AKAET LENGG	VIMQAF YWDV	PGGGIWWDTI	AQKIPDWA SA	GISAIWIPPA
SEQ ID NO:76	---MA LEEGG	LIMQAF YWDV	PMGGIWWDTI	AQKIPDWA SA	GISAIWIPPA
SEQ ID NO:78	---MA LEEGG	LIMQAF YWDV	PMGGIWWDTI	AQKIPDWA SA	GISAIWIPPA
SEQ ID NO:84	---MA LEEGG	LIMQAF YWDV	PGGGIWWDTI	AQKIPDWA SA	GISAIWIPPA
SEQ ID NO:86	---MA LEEGG	LIMQAF YWDV	PGGGIWWDTI	AQKIPDWA SA	GISAIWIPPA
SEQ ID NO:80	AKYLE LEEGG	VIMQAF YWDV	PSGGIWWDTI	RQKIPEWY DA	GISAIWIPPA
thermo (SEQ ID NO:315)	TSRPS LEEGG	VIMQAF YWDV	PAGGIWWDTI	RSKIPDWA SA	GISAIWIPPA
pyro2 (SEQ ID NO:314)	AKYLE LEEGG	VIMQAF YWDV	PGGGIWWDTI	RSKIPEWY EA	GISAIWIPPA
CLONE A (SEQ ID NO:318)	AKYSE LEQGG	VIMQAF YWDV	PEGGIWWDTI	RQKIPEWY DA	GISAIWIPPA
Consensus (SEQ ID NO:319)	-----GG	-IMQAF YWDV	P-GGIWWDTI	--KIP-W--A	GISAIW-PP-
	101				150
SEQ ID NO:82	SKGMS GGYSM	GYDPYD FFDL	GEYNQKG TIE	TRFGSKQE LI	NMINTAHAY G
pyro (SEQ ID NO:313)	SKGMG GAYSM	GYDPYD FFDL	GEYNQKG TVE	TRFGSKQE LI	NMINTAHAY G
SEQ ID NO:74	SKGMS GGYSM	GYDPYD FFDL	GEYYQKG SVE	TRFGSKEE LV	NMINTAHAY N
thermo2 (SEQ ID NO:316)	SKGMS GGYSM	GYDPYD FFDL	GEYYQKG SVE	TRFGSKEE LV	NMINTAHAY N
SEQ ID NO:76	SKGMS GGYSM	GYDPYD YFDL	GEYYQKG TVE	TRFGSKQE LI	NMINTAHAY G
SEQ ID NO:78	SKGMS GGYSM	GYDPYD YFDL	GEYYQKG TVE	TRFGSKQE LI	NMINTAHAY G
SEQ ID NO:84	SKGMS GGYSM	GYDPYD FFDL	GEYYQKG TVE	TRFGSKEE LV	NMINTAHAY G
SEQ ID NO:86	SKGMS GGYSM	GYDPYD FFDL	GEYYQKG TVE	TRFGSKEE LV	NMINTAHAY G
SEQ ID NO:80	SKGMG GAYSM	GYDPYD FFDL	GEYDQKG TVE	TRFGSKQE LV	NMINTAHAY G
thermo (SEQ ID NO:315)	SKGMS GAYSM	GYDPYD FFDL	GEYYQKG TVE	TRFGSKQE LI	NMINTAHAY G
pyro2 (SEQ ID NO:314)	SKGMS GGYSM	GYDPYD YFDL	GEYYQKG TVE	TRFGSKEE LV	RLIQTAHAY G
CLONE A (SEQ ID NO:318)	SKGMG GAYSM	GYDPYD YFDL	GEFYQKG TVE	TRFGSKEE LV	NMISTAHQY G
Consensus (SEQ ID NO:319)	SKGM- G-YSM	GYDPYD -FDL	GE--QKG --E	TRFGSK-E-L-	--I-TAH--
	151				200
SEQ ID NO:82	IKVIADIVIN	HRAGGD LEWN	PFVGDYT WTD	FSKVASGK YT	ANYLDFHPN E
pyro (SEQ ID NO:313)	IKVIADIVIN	HRAGGD LEWN	PFVGDYT WTD	FSKVASGK YT	ANYLDFHPN E
SEQ ID NO:74	MKVIADIVIN	HRAGGD LEWN	PFTNSYT WTD	FSKVASGK YT	ANYLDFHPN E
thermo2 (SEQ ID NO:316)	MKVIADIVIN	HRAGGD LEWN	PFTNSYT WTD	FSKVASGK YT	ANYLDFHPN E
SEQ ID NO:76	MKVIADIVIN	HRAGGD LEWN	PFVNDYT WTD	FSKVASGK YT	ANYLDFHPN E
SEQ ID NO:78	MKVIADIVIN	HRAGGD LEWN	PFVNDYT WTD	FSKVASGK YT	ANYLDFHPN E
SEQ ID NO:84	IKVIADIVIN	HRAGGD LEWN	PFVNDYT WTD	FSKVASGK YT	ANYLDFHPN E
SEQ ID NO:86	IKVIADIVIN	HRAGGD LEWN	PFVNDYT WTD	FSKVASGK YT	ANYLDFHPN E
SEQ ID NO:80	IKVIADIVIN	HRAGGD LEWN	PFVNDYT WTD	FSKVASGK YT	ANYLDFHPN E
thermo (SEQ ID NO:315)	IKVIADIVIN	HRAGGD LEWN	PFTNSYT WTD	FSKVASGK YT	ANYLDFHPN E
pyro2 (SEQ ID NO:314)	IKVIADIVIN	HRAGGD LEWN	PFVGDYT WTD	FSKVASGK YT	ANYLDFHPN E
CLONE A (SEQ ID NO:318)	IKVIADIVIN	HRAGGD LEWN	PFVGDYT WTD	FSKVASGK YT	ANYLDFHPN E
Consensus (SEQ ID NO:319)	-KVIAD-VIN	HRAGG- LEWN	P----YT WTD	FSKVASGK Y-	A-Y-DFHPN -

Figure 14B-1



	201		250		
SEQ ID NO:82	VKCCDEGTFG	GFPDIA HEKS	WDQHWLW ASD	ESYAAYLR SI	GVDARWFDY V
pyro (SEQ ID NO:313)	VKCCDEGTFG	GFPDIA HEKE	WDQHWLW ASD	ESYAAYLR SI	GVDARWFDY V
SEQ ID NO:74	LHAGD SGTFG	GYPDIC HDKS	WDQHWLW ASN	ESYAAYLR SI	GIDARWFDY V
thermo2 (SEQ ID NO:316)	LHAGD SGTFG	GYPDIC HDKS	WDQHWLW ASN	ESYAAYLR SI	GIDARWFDY V
SEQ ID NO:76	LHAGD SGTFG	GYPDIC HDKS	WDQYWLW ASQ	ESYAAYLR SI	GIDARWFDY V
SEQ ID NO:78	LHAGD SGTFG	GYPDIC HDKS	WDQYWLW ASQ	ESYAAYLR SI	GIDARWFDY V
SEQ ID NO:84	LHCCDEGTFG	GYPDIC HDKS	WDQYWLW ASS	ESYAAYLR SI	GVDARWFDY V
SEQ ID NO:86	LHCCDEGTFG	GYPDIC HDKS	WDQYWLW ASS	ESYAAYLR SI	GVDARWCFDY V
SEQ ID NO:80	VKCCDEGTFG	GFPDIA HEKS	WDQYWLW ASN	ESYAAYLR SI	GVDARWFDY V
thermo (SEQ ID NO:315)	VKCCDEGTFG	GFPDIA HEKS	WDQYWLW ASQ	KSAYAAYLR SI	GIDARWFDY V
pyro2 (SEQ ID NO:314)	LHCCDEGTFG	GFPDICH HEKE	WDQYWLW KSN	ESYAAYLR SI	GFDGWRFDY V
CLONE A (SEQ ID NO:318)	YSTSDEGTFG	GFPDID HLVP	FNQYWLW ASN	ESYAAYLR SI	GIDARWFDY V
Consensus (SEQ ID NO:319)	---D-GTFG	G-PDI-H---	--Q-WLW-S-	-SYAAYLR SI	G-D-W-FDY V
	251		300		
SEQ ID NO:82	KGYGA WVVKD	WLNWWG GWAV	GEYWDTN VDA	LLNWAYSS GA	KVFDFPLYY K
pyro (SEQ ID NO:313)	KGYGA WVVKD	WLNWWG GWAV	GEYWDTN VDA	LLNWAYSS GA	KVFDFPLYY K
SEQ ID NO:74	KGYAP WVVKD	WLNWWG GWAV	GEYWDTN VDA	LLSWAYDS GA	KVFDFPLYY K
thermo2 (SEQ ID NO:316)	KGYAP WVVKD	WLNWWG GWAV	GEYWDTN VDA	LLSWAYDS GA	KVFDFPLYY K
SEQ ID NO:76	KGYAP WVVRD	WLNWWG GWAV	GEYWDTN VDA	VLNWAYSS GA	KVFDFALYY K
SEQ ID NO:78	KGYAP WVVKD	WLNWWG GWAV	GEYWDTN VDA	VLNWAYSS GA	KVFDFALYY K
SEQ ID NO:84	KGYGA WVVND	WLSWWG GWAV	GEYWDTN VDA	LLNWAYSS GA	KVFDFPLYY K
SEQ ID NO:86	KGYGA WVVND	WLSWWG GWAV	GEYWDTN VDA	LLNWAYNS GA	KVFDFPLYY K
SEQ ID NO:80	KGYGA WVVKD	WLDWWG GWAV	GEYWDTN VDA	LLNWAYSS DA	KVFDFPLYY K
thermo (SEQ ID NO:315)	KGYGA WVVKD	WLKWW . ALAV	GEYWDTN VDA	LLNWAYSS GA	KVFDFPLYY K
pyro2 (SEQ ID NO:314)	KGYGA WVVRD	WLNWWG GWAV	GEYWDTN VDA	LLSWAYES GA	KVFDFPLYY K
CLONE A (SEQ ID NO:318)	KGYGA WVVKD	WLSQWG GWAV	GEYWDTN VDA	LLNWAYSS GA	KVFDFPLYY K
Consensus (SEQ ID NO:319)	KGY--WVV--	WL--W-- --AV	GEYWDTN VDA	-L-WAY-S-A	KVFDF-LYY K
	301		350		
SEQ ID NO:82	MDEAF DNKNI	PALVSA LQNG	QTVVSRD PFK	AVTFVANH DT	DIIWNKYLA Y
pyro (SEQ ID NO:313)	MDEAF DNTNI	PALVDA LQNG	QTVVSRD PFK	AVTFVANH DT	DIIWNKYPA Y
SEQ ID NO:74	MDEAF DNNNI	PALVDA LKNG	QTVVSRD PFK	AVTFVANH DT	NIIWNKYPA Y
thermo2 (SEQ ID NO:316)	MDEAF DNNNI	PALVDA LKNG	QTVVSRD PFK	AVTFVANH DT	NIIWNKYPA Y
SEQ ID NO:76	MDEAF DNNNI	PALVDA LRYG	QTVVSRD PFK	AVTFVANH DT	DIIWNKYPA Y
SEQ ID NO:78	MDEAF DNNNI	PALVDA LRYG	QTVVSRD PFK	AVTFVANH DT	DIIWNKYPA Y
SEQ ID NO:84	MDEAF DNTNI	PALVDA LRYG	QTVVSRD PFK	AVTFVANH DT	DIIWNKYPA Y
SEQ ID NO:86	MDEAF DNTNI	PALVYA LKNG	QTVVSRD PFK	AVTFVANH DT	DIIWNKYPA Y
SEQ ID NO:80	MDAAF DNKNI	PALVEA LKNG	QTVVSRD PFK	AVTFVANH DT	DIIWNKYPA Y
thermo (SEQ ID NO:315)	MDEAF DNKNI	PALVSA LQNG	QTVVSRD PFK	AVTFVANH DT	DIIWNKYPA Y
pyro2 (SEQ ID NO:314)	MDEAF DNNNI	PALVYA LQNG	QTVVSRD PFK	AVTFVANH DT	DIIWNKYPA Y
CLONE A (SEQ ID NO:318)	MDEAF DNKNI	PALVYA IQNG	ETVVSRD PFK	AVTFVANH DT	NIIWNKYPA Y
Consensus (SEQ ID NO:319)	MD-AF DN-NI	PALV-A ---G	-TVVSRD PFK	AVTFVANH DT	-I IWNKY-A Y
	351		400		
SEQ ID NO:82	AFILTYEGQP	VIFYRD YEEW	LNKDRLN NLI	WIHDHLAG GS	TSIVYYDSDE
pyro (SEQ ID NO:313)	AFILTYEGQP	VIFYRD YEEW	LNKDKLN NLI	WIHDHLAG GS	TSIVYYDSDE
SEQ ID NO:74	AFILTYEGQP	AIFYRD YEEW	LNKDRLR NLI	WIHDHLAG GS	TDIIYYDSDE
thermo2 (SEQ ID NO:316)	AFILTYEGQP	AIFYRD YEEW	LNKDRLR NLI	WIHDHLAG GS	TDIIYYDSDE
SEQ ID NO:76	AFILTYEGQP	TIFYRD YEEW	LNKDKLN NLI	WIHDNLAG GS	TDIVYYDNDE
SEQ ID NO:78	AFILTYEGQP	TIFYRD YEEW	LNKDKLN NLI	WIHDNLAG GS	TDIVYYDNDE
SEQ ID NO:84	AFILTYEGQP	VIFYRD YEEW	LNKDKLN NLI	WIHDHLAG GS	TDIVYYDSDE
SEQ ID NO:86	AFILTYEGQP	VIFYRD YEEW	LNKDKLN NLI	WIHDHLAG GS	TDIVYYDSDE
SEQ ID NO:80	AFILTYEGQP	TIFYRD YEEW	LNKDKLN NLI	WIHDHLAG GS	TDIVYYDNDE
thermo (SEQ ID NO:315)	AFILTYEGQP	VIFYRD YEEW	LNKDKLN NLI	WIHNNLAG GS	TSIVYYDNDE
pyro2 (SEQ ID NO:314)	AFILTYEGQP	VIFYRD FEW	LNKDKLI NLI	WIHDHLAG GS	TTIVYYDNDE
CLONE A (SEQ ID NO:318)	AFILTYEGQP	VIFYRD YEEW	LNKDKLN NLI	WIHEHLAG GS	TKILYYDDDE
Consensus (SEQ ID NO:319)	AFILTYEGQP	-IFYRD -EEW	LNKD-L- NLI	WIH--LAG GS	T-I-YYD-DE

Figure 14B-2



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Applicant(s): Walter Callen et al.

ENZYMES HAVING ALPHA AMYLASE ACTIVITY AND  
METHODS OF USE THEREOF

	401		450
SEQ ID NO:82	MIFVRNGYGS	KPGLITYINL	GSSKVGRWVY V.PKFAGACI HEYTGNLGGW
pyro (SEQ ID NO:313)	LIFVRNGDSK	RPGLITYINL	GSSKVGRWVY V.PKFAGACI HEYTGNLGGW
SEQ ID NO:74	LIFVRNGYGD	KPGLITYINL	GSSKAGR WVY V.PKFAGSCI HEYTGNLGGW
thermo2 (SEQ ID NO:316)	LIFVRNGYGD	KPGLITYINL	GSSKAGR WVY V.PKFAGSCI HEYTGNLGGW
SEQ ID NO:76	LIFVRNGYGS	KPGLITYINL	GSSKAGR WVY V.PKFAGSCI HEYTGNLGGW
SEQ ID NO:78	LIFVRNGYGS	KPGLITYINL	ASSKAGR WVY V.PKFAGSCI HEYTGNLGGW
SEQ ID NO:84	LIFVRNGYGT	KPGLITYINL	GSSKVGR WVY V.PKFAGSCI HEYTGNLGGW
SEQ ID NO:86	LIFVRNGYGT	KPGLITYINL	GSSKAGR WVY V.PKFAGSCI HEYTGSLGGW
SEQ ID NO:80	LIFVRNGYGD	KPGLITYINL	GSSKAGR WVY V.PKFAGACI HEYTGNLGGW
thermo (SEQ ID NO:315)	LIFVRNGYGN	KPGLITYINL	GSSKVGR WVY V.PKFAGSCI HEYTGNLGGW
pyro2 (SEQ ID NO:314)	LIFVRNGDSR	RPGLITYINL	SPNWVGR WVY V.PKFAGACI HEYTGNLGGW
CLONE A (SEQ ID NO:318)	LIFMR EGYGD	RPGLITYINL	GSDWAER WVN VGSKFAGY TI HEYTGNLGGW
Consensus (SEQ ID NO:319)	-IF-R -G---	-PGLITYINL	-----RWV- V--KFAG- -I HEYTG-LGGW
	451		487
SEQ ID NO:82	VDKYV YSSGW	VYFEAP AYDP	ANGQYGY SVW SYCGVG*
pyro (SEQ ID NO:313)	VDKYV ESSGW	VYLEAP AYDP	ASGQYGY TVW SYCGVG*
SEQ ID NO:74	IDKWV DSSGR	VYLEAP AHDP	ANGQYGY SVW SYCGVG*
thermo2 (SEQ ID NO:316)	IDKWV DSSGR	VYLEAP AHDP	ANGQYGY SVW SYCGVG*
SEQ ID NO:76	VDKWV DSSGW	VYLEAP AHDP	ANGQYGY SVW SYCGVG*
SEQ ID NO:78	VDKWV DSSGW	VYLEAP AHDP	ANGQYGY SVW SYCGVG*
SEQ ID NO:84	IDKYV SSSGW	VYLEAP AHDP	ANGYYGY SVW SYCGVG*
SEQ ID NO:86	IDKYV SSSGW	VYLEAP AHDP	ANGQYGY SVW SYCGVG*
SEQ ID NO:80	VDKWV DSSGW	VYLEAP AHDP	ANGYYGY SVW SYCGVG*
thermo (SEQ ID NO:315)	VDKYV GSNGW	VYLEAP AHDP	AKGQYGY SVW SYCGVG*
pyro2 (SEQ ID NO:314)	VDKRV DSSGW	VYLEAP PHDP	ANGYYGY SVW SYCGVG*
CLONE A (SEQ ID NO:318)	VDKYV QYDGW	VKLTAP PHDP	ANGYYGY SVW SYAGVG*
Consensus (SEQ ID NO:319)	-D--V ---G-	V---AP --DP	A-G-YGY -VW SY-GVG*

Figure 14B-3



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Applicant(s): Walter Callen et al.

ENZYMES HAVING ALPHA AMYLASE ACTIVITY AND  
METHODS OF USE THEREOF

	1				50
SEQ ID NO:83	-----	-----	-----	-----	-----
SEQ ID NO:85	-----	-----	-----	-----	-----
SEQ ID NO:75	-----	-----	-----	-----	-----
SEQ ID NO:77	-----	-----	-----	-----	-----
SEQ ID NO:73	-----	-----	-----	-----	-----
SEQ ID NO:79	----ATGA AGC	CTGCGAAA CT	CCTCGTCTT T	GTGCTCGTAG	TCTCTATCCT
SEQ ID NO:81	----ATGA AGA	AGTTTGTC GC	CCTGTTCAT A	ACCATGTTTT	TCGTAGTGAG
CLONE A (SEQ ID NO:320)	ATGAGGA GAT	CCGCAAGG GT	TTTGGTTCT G	ATTATAGCGT	TTTTCTCTCT
Consensus (SEQ ID NO:321)	-----	-----	-----	-----	-----
	51				100
SEQ ID NO:83	-----	-----	-----	-----	ATGGCTCTGG
SEQ ID NO:85	-----	-----	-----	-----	ATGGCTCTGG
SEQ ID NO:75	-----	-----	-----	-----	ATGGCTCTGG
SEQ ID NO:77	-----	-----	-----	-----	ATGGCTCTGG
SEQ ID NO:73	-----	-----	-----	-----	ATGGCTCTGG
SEQ ID NO:79	CGCGGGG CTC	TACGCCCCA GC	CCGCGGGGG C	GGCCAAGTAC	CTGGAGCTCG
SEQ ID NO:81	CATGGCA GTC	GTTGCACA GC	CAGCTAGCG C	CGCAAAGTAT	TCCGAGCTCG
CLONE A (SEQ ID NO:320)	GGCGGGG ATT	TACTACCC CT	CCACGAGTG C	CGCGAAGTAC	TCCGAGCTGG
Consensus (SEQ ID NO:321)	-----	-----	-----	-----	-----
	101				150
SEQ ID NO:83	AAGAGGG CGG	GCTCATAA TG	CAGGCCTTC T	ACTGGGATGT	TCCTGGAGGA
SEQ ID NO:85	AAGAGGG CGG	GCTTATAA TG	CAGGCATTC T	ATTGGGACGT	CCCAGGTGGA
SEQ ID NO:75	AAGAGGG CGG	GCTTATAA TG	CAGGCATTC T	ACTGGGACGT	CCCCATGGGA
SEQ ID NO:77	AAGAGGG CGG	GCTCATAA TG	CAGGCCTTC T	ACTGGGACGT	CCCCATGGGA
SEQ ID NO:73	TAGAGGG CGG	GCTTATAA TG	CAGGCCTTC T	ACTGGGACGT	CCCAGGTGGA
SEQ ID NO:79	AAGAGGG CGG	CGTCATAA TG	CAGGCGTTC T	ACTGGGACGT	GCCTTCAGGA
SEQ ID NO:81	AAGAAGG CGG	CGTTATAA TG	CAGGCCTTC T	ACTGGGACGT	CCCAGGTGGA
CLONE A (SEQ ID NO:320)	AGCAGGG CGG	AGTCATAA TG	CAGGCCTTC T	ACTGGGACGT	TCCGGAGGGA
Consensus (SEQ ID NO:321)	----GG CGG	--T-ATAA TG	CAGGC-TTC T	A-TGGGA-GT	-CC----GGA
	151				200
SEQ ID NO:83	GGAATCT GGT	GGGACACA AT	AGCTCAAAA G	ATACCCGAAT	GGGCAAGTGC
SEQ ID NO:85	GGAATCT GGT	GGGACACC AT	AGCCCAGAA G	ATACCCGAAT	GGGCAAGTGC
SEQ ID NO:75	GGAATCT GGT	GGGACACG AT	AGCCCAGAA G	ATACCCGACT	GGGCAAGCGC
SEQ ID NO:77	GGAATCT GGT	GGGACACG AT	AGCCCAGAA G	ATACCCGACT	GGGCAAGCGC
SEQ ID NO:73	GGAATCT GGT	GGGACACC AT	AGCCCAGAA G	ATACCCGACT	GGGCGAGCGC
SEQ ID NO:79	GGAATAT GGT	GGGACACA AT	ACGGCAGAA G	ATACCGGAGT	GGTACGATGC
SEQ ID NO:81	GGAATCT GGT	GGGACACC AT	CAGGAGCAA G	ATACCGGAGT	GGTACGAGGC
CLONE A (SEQ ID NO:320)	GGAATCT GGT	GGGACACA AT	ACGGCAGAA G	ATCCCTGAAT	GGTACGATGC
Consensus (SEQ ID NO:321)	GGAAT-T GGT	GGGACAC- AT	-----AA G	AT-CC-GA-T	GG-----GC
	201				250
SEQ ID NO:83	AGGAATC TCA	GCGATATG GA	TTCCACCAG C	GAGTAAGGGC	ATGAGCGGTG
SEQ ID NO:85	AGGAATC TCA	GCGATATG GA	TTCCACCAG C	GAGTAAGGGA	ATGAGCGGTG
SEQ ID NO:75	CGGGATT TCG	GCGATATG GA	TTCCCCCGG C	GAGCAAGGGT	ATGAGCGGCG
SEQ ID NO:77	CGGGATT TCG	GCGATATG GA	TCCCTCCCG C	GAGCAAGGGT	ATGAGCGGCG
SEQ ID NO:73	CGGGATT TCG	GCAATATG GA	TTCTTCCCG C	GAGTAAGGGC	ATGAGCGGCG
SEQ ID NO:79	CGGAATC TCC	GCAATATG GA	TTCCCCCGG C	GAGCAAGGGC	ATGGGCGGCG
SEQ ID NO:81	GGGAATA TCC	GCCATTTG GA	TTCCGCCAG C	CAGCAAGGGG	ATGAGCGGCG
CLONE A (SEQ ID NO:320)	AGGCATA TCC	GCCATCTG GA	TACCCCGG C	GAGCAAGGGC	ATGGGCGGGG
Consensus (SEQ ID NO:321)	-GG-AT- TC-	GC-AT-TG GA	T-CC-CC-G C	-AG-AAGGG-	ATG-GCGG-G

Figure 14C-1



251 300  
SEQ ID NO:83 GTTATTC CAT GGGCTACG AT CCCTACGAT T TCTTTGACCT CGGCGAGTAC  
SEQ ID NO:85 GTTATTC CAT GGGCTACG AT CCCTACGAT T TCTTTGACCT CGGCGAGTAC  
SEQ ID NO:75 GCTATTC GAT GGGCTACG AC CCCTACGAT T ATTTTGACCT CGGTGAGTAC  
SEQ ID NO:77 GCTATTC GAT GGGCTACG AC CCCTACGAT T ATTTTGACCT CGGTGAGTAC  
SEQ ID NO:73 GCTATTC GAT GGGCTACG AC CCCTACGAT T TCTTCGACCT CGGTGAGTAC  
SEQ ID NO:79 CCTATTC GAT GGGCTACG AC CCCTACGAT T TCTTTGACCT CGGTGAGTAC  
SEQ ID NO:81 GTTACTC GAT GGGCTACG AT CCCTACGAT T TCTTTGACCT CGGCGAGTAC  
CLONE A (SEQ ID NO:320) CCTACTC GAT GGGCTACG AC CCCTACGAT T ACTTCGATCT GGGCGAGTTT  
Consensus (SEQ ID NO:321) --TA-TC -AT GGGCTACG A- CCCTACGA- T --TT-GA-CT -GG-GAGT--

301 350  
SEQ ID NO:83 TATCAGA AGG GGACAGTT GA GACGCGCTT C GGCTCAAAGG AAGAAGCTGGT  
SEQ ID NO:85 TATCAGA AGG GGACAGTT GA GACGCGCTT C GGCTCAAAGG AAGAAGCTGGT  
SEQ ID NO:75 TACCAGA AGG GAACGGTG GA AACAAGATT C GGCTCAAAGC AGGAGCTCAT  
SEQ ID NO:77 TACCAGA AGG GAACGGTG GA AACGAGGTT C GGCTCAAAGC AGGAGCTCAT  
SEQ ID NO:73 TACCAGA AGG GAAGCGTT GA GACCCGCTT C GGATCAAAAG AGGAGCTTGT  
SEQ ID NO:79 GACCAGA AGG GAACGGTA GA GACGCGCTT T GGCTCCAAGC AGGAGCTCGT  
SEQ ID NO:81 AACCAGA AGG GAACCATC GA AACGCGCTT T GGCTCTAAAC AGGAGCTCAT  
CLONE A (SEQ ID NO:320) TACCAGA AGG GAACGGTT GA GACCCGCTT C GGCTCCAAGG AAGAGCTCGT  
Consensus (SEQ ID NO:321) -A-CAGA AGG G-A-- -T-GA -AC--G-TT -GG-TC-AA-- A-GA-CT--T

351 400  
SEQ ID NO:83 GAACATG ATA AACACCGC AC ACTCCTACG G CATAAAGGTG ATAGCAGACA  
SEQ ID NO:85 GAACATG ATA AACACCGC AC ACTCCTACG G CATAAAGGTG ATAGCGGACA  
SEQ ID NO:75 AAACATG ATA AACACCGC CC ACGCCTATG G CATGAAGGTA ATAGCCGATA  
SEQ ID NO:77 AAACATG ATA AACACCGC CC ACGCCTATG G CATGAAGGTA ATAGCCGATA  
SEQ ID NO:73 GAACATG ATA AACACCGC CC ATGCTCACA A CATGAAGGTC ATAGCGGACA  
SEQ ID NO:79 GAACATG ATA AACACCGC CC ACGCCTACG G CATCAAGGTC ATCGCAGACA  
SEQ ID NO:81 CAATATG ATA AACACGGC CC ATGCCTACG G CATAAAGGTC ATAGCGGACA  
CLONE A (SEQ ID NO:320) CAACATG ATC TCCACGGC CC ACCAGTACG G CATCAAGGTT ATAGCGGACA  
Consensus (SEQ ID NO:321) -AA-ATG AT- --CAC-GC -C A-----A-- -CAT-AAGGT- AT-GC-GA-A

401 450  
SEQ ID NO:83 TAGTCAT AAA CCACCGCG CC GGTGGAGAC C TTGAGTGGAA CCCCTTCGTG  
SEQ ID NO:85 TAGTCAT AAA CCACCGCG CC GGTGGAGGC C TCGAGTGGAA CCCCTTCGTG  
SEQ ID NO:75 TAGTCAT CAA CCACCGCG CC GGCGGCGAT C TGGAGTGGAA CCCCTTCGTG  
SEQ ID NO:77 TAGTCAT CAA CCACCGCG CC GGCGGTGAC C TGGAGTGGAA CCCCTTCGTG  
SEQ ID NO:73 TAGTCAT CAA CCACCGCG CC GGCGGCGAC C TGGAGTGGAA TCCTTTCACC  
SEQ ID NO:79 TAGTAAT CAA CCACCGCG CC GGAGGAGAC C TTGAGTGGAA CCCCTTCGTC  
SEQ ID NO:81 TCGTCAT AAA CCACCGCG CA GGCGGAGAC C TCGAGTGGAA CCCGTTTCGT  
CLONE A (SEQ ID NO:320) TAGTGAT AAA CCACCGCG CA GGTGGAGAC C TCGAATGGAA CCCATACGTC  
Consensus (SEQ ID NO:321) T-GT-AT -AA CCACCGCG C- GG-GG-G-- C T-GA-TGGAA -CC-T-C---

451 500  
SEQ ID NO:83 AACGACT ATA CCTGGACA GA CTTCTCAAA A GTCGCCTCCG GTAAATATAC  
SEQ ID NO:85 AACGACT ATA CCTGGACA GA CTTCTCAAA A GTCGCCTCCG GTAAATATAC  
SEQ ID NO:75 AACGACT ATA CCTGGACC GA CTTCTCGAA G GTCGCGTCGG GTAAATACAC  
SEQ ID NO:77 AACGACT ATA CCTGGACC GA CTTCTCAAA G GTCGCGTCGG GTAAATACAC  
SEQ ID NO:73 AACAGCT ACA CCTGGACC GA TTTCTCGAA G GTCGCGTCGG GCAAGTACAC  
SEQ ID NO:79 AATGACT ACA CCTGGACG GA CTTCTCGAA G GTCGCTTCCG GCAAGTACAC  
SEQ ID NO:81 GGGGACT ACA CCTGGACG GA CTTCTCAAA G GTGGCCTCGG GCAAATATAC  
CLONE A (SEQ ID NO:320) GGCGACT ATA CCTGGACG GA CTTTCTAA G GTCGCCTCCG GGAAATACAA  
Consensus (SEQ ID NO:321) -----CT A-A CCTGGAC- GA -TT-TC-AA -GT-GC-TC-G G-AA-TA-A-

Figure 14C-2



	501				550
SEQ ID NO:83	GGCCAAC TAC	CTTGACTT CC	ACCCAAACG A	GCTTCACTGT	TGTGATGAAG
SEQ ID NO:85	AGCCAAC TAC	CTTGACTT CC	ACCCAAACG A	GCTTCACTGT	TGTGATGAAG
SEQ ID NO:75	GGCCAAC TAC	CTCGACTT CC	ACCCGAACG A	GCTCCACGCG	GGCGATTCCG
SEQ ID NO:77	GGCCAAC TAC	CTCGACTT CC	ACCCGAACG A	GCTCCATGCG	GGCGATTCCG
SEQ ID NO:73	GGCCAAC TAC	CTCGACTT CC	ACCCGAACG A	GCTTCACGCG	GGCGATTCCG
SEQ ID NO:79	GGCCAAC TAC	CTCGACTT CC	ACCCCAACG A	GGTCAAGTGC	TGCGACGAGG
SEQ ID NO:81	TGCCAAC TAC	CTCGACTT CC	ACCCCAACG A	GGTCAAGTGC	TGTGACGAGG
CLONE A (SEQ ID NO:320)	GGCCAC TAC	ATGGACTT CC	ATCCAAACA A	CTACAGCACC	TCAGACGAGG
Consensus (SEQ ID NO:321)	-GCC-AC TAC	-T-GACTT CC	A-CC-AAC- A	-----	---GA----
	551				600
SEQ ID NO:83	GTACCTT TGG	AGGATACC CT	GATATATGT C	ACGACAAAAG	CTGGGACCAG
SEQ ID NO:85	GTACCTT TGG	AGGATACC CT	GATATATGT C	ACGACAAAAG	CTGGGACCAG
SEQ ID NO:75	GAACATT TGG	AGGCTATC CC	GACATATGC C	ACGACAAGAG	CTGGGACCAG
SEQ ID NO:77	GAACATT TGG	AGGCTATC CC	GACATATGC C	ACGACAAGAG	CTGGGACCAG
SEQ ID NO:73	GAACATT TGG	AGGCTATC CC	GACATATGC C	ACGACAAGAG	CTGGGACCAG
SEQ ID NO:79	GCACCTT TGG	AGGGTTCC CG	GACATAGCC C	ACGAGAAGAG	CTGGGACCAG
SEQ ID NO:81	GCACATT TGG	AGGCTTCC CA	GACATAGCC C	ACGAGAAGAG	CTGGGACCAG
CLONE A (SEQ ID NO:320)	GAACCTT CGG	TGGCTTCC CA	GACATTGAT C	ACCTCGTGCC	CTTCAACCAG
Consensus (SEQ ID NO:321)	G-AC-TT -GG	-GG-T--C -	GA-AT---- C	AC-----	CT---ACCAG
	601				650
SEQ ID NO:83	TACTGGC TCT	GGGCGAGC AG	CGAAAGCTA C	GCTGCCTACC	TCAGGAGCAT
SEQ ID NO:85	TACTGGC TCT	GGGCGAGC AG	CGAAAGCTA C	GCTGCCTACC	TCAGGAGCAT
SEQ ID NO:75	TACTGGC TCT	GGGCCAGC CA	GGAGAGCTA C	GCGGCCTATC	TCAGGAGCAT
SEQ ID NO:77	TACTGGC TCT	GGGCCAGC CA	GGAGAGCTA C	GCGGCATATC	TCAGGAGCAT
SEQ ID NO:73	CACTGGC TCT	GGGCCAGC AA	CGAAAGCTA C	GCCGCCTACC	TCCGGAGCAT
SEQ ID NO:79	TACTGGC TCT	GGGCGAGC AA	CGAGAGCTA C	GCCGCCTACC	TCAGGAGCAT
SEQ ID NO:81	CACTGGC TCT	GGGCGAGC GA	TGAGAGCTA C	GCCGCCTACC	TAAGGAGCAT
CLONE A (SEQ ID NO:320)	TACTGGC TGT	GGGCGAGC AA	CGAGAGCTA C	GCCGCCTACC	TCAGGAGCAT
Consensus (SEQ ID NO:321)	-ACTGGC T-T	GGGC-AGC --	-GA-AGCTA C	GC-GC-TA -C	T--GGAGCAT
	651				700
SEQ ID NO:83	AGGGGTT GAC	GCCTGGCG TT	TCGACTACG T	CAAGGGCTAC	GGAGCATGGG
SEQ ID NO:85	AGGGGTT GAC	GCCTGGTG TT	TCGACTACG T	CAAGGGCTAC	GGAGCCTGGG
SEQ ID NO:75	CGGCATC GAC	GCCTGGCG CT	TCGACTACG T	CAAGGGCTAT	GCTCCCTGGG
SEQ ID NO:77	CGGCATC GAT	GCCTGGCG CT	TCGACTACG T	CAAGGGCTAT	GCTCCCTGGG
SEQ ID NO:73	CGGCATC GAC	GCCTGGCG CT	TCGACTACG T	CAAGGGCTAC	GCTCCCTGGG
SEQ ID NO:79	CGGCGTT GAC	GCATGGCG CT	TCGACTACG T	CAAGGGCTAC	GGAGCCTGGG
SEQ ID NO:81	CGGCGTT GAT	GCCTGGCG CT	TTGACTACG T	GAAGGGCTAC	GGAGCGTGGG
CLONE A (SEQ ID NO:320)	AGGGATC GAT	GCGTGGCG CT	TTGACTACG T	TAAGGGCTAC	GGGCGTGGG
Consensus (SEQ ID NO:321)	-GG--T- GA-	GC-TGG-G -T	T-GACTACG T	-AAGGGCTA-	G---C-TGGG
	701				750
SEQ ID NO:83	TTGTTAA CGA	CTGGCTCAG C	TGGTGGGGA G	GCTGGGCCGT	TGGAGAGTAC
SEQ ID NO:85	TTGTTAA CGA	CTGGCTCAG C	TGGTGGGGA G	GCTGGGCCGT	TGGAGAGTAC
SEQ ID NO:75	TCGTCAA GGA	CTGGCTGAA C	TGGTGGGGA G	GCTGGGCAGT	TGGAGAGTAC
SEQ ID NO:77	TCGTCAA GGA	CTGGCTGAA C	TGGTGGGGA G	GCTGGGCCGT	TGGAGAGTAC
SEQ ID NO:73	TCGTCAA GAA	CTGGCTGAA C	CGGTGGGGC G	GCTGGGCCGT	TGGAGAGTAC
SEQ ID NO:79	TCGTCAA GGA	CTGGCTGGA C	TGGTGGGGA G	GCTGGGCCGT	CGGGAGTAC
SEQ ID NO:81	TCGTCAA GGA	CTGGCTCAA C	TGGTGGGGC G	GCTGGGCCGT	TGGCAGTAC
CLONE A (SEQ ID NO:320)	TCGTCAA GGA	CTGGCTGAA GT	CAGTGGGGC G	GCTGGGCCGT	CGGCCAGTAC
Consensus (SEQ ID NO:321)	T-GT-A- - -A	CTGGCT-- - -	--GTGGGG- G	GCTGGGC-GT	-GG-GAGTAC

Figure 14C-3



	751				800
SEQ ID NO:83	TGGGACA CGA	ACGTTGAT GC	ACTCCTCAA C	TGGGCATACA	GCAGCGGCGC
SEQ ID NO:85	TGGGACA CTA	ACGTTGAT GC	ACTCCTCAA C	TGGGCATACA	ACAGCGGCGC
SEQ ID NO:75	TGGGACA CCA	ACGTCGAC GC	TGTTCTCAA C	TGGGCATACT	CGAGCGGTGC
SEQ ID NO:77	TGGGACA CCA	ACGTCGAC GC	TGTTCTCAA C	TGGGCATACT	CGAGCGGTGC
SEQ ID NO:73	TGGGACA CCA	ACGTCGAT GC	ACTCCTGAG C	TGGGCCTACG	ACAGCGGTGC
SEQ ID NO:79	TGGGACA CAA	ACGTTGAT GC	ACTGCTCAA C	TGGGCCTACT	CGAGCGATGC
SEQ ID NO:81	TGGGACA CCA	ACGTTGAT GC	ACTCCTCAA C	TGGGCCTACT	CGAGCGGCGC
CLONE A (SEQ ID NO:320)	TGGGACA CCA	ACGTCGAT GC	GCTCCTCAA C	TGGGCCTACA	GCAGCGGCGC
Consensus (SEQ ID NO:321)	TGGGACA C-A	ACGT-GA- GC	- - T-CT-A- C	TGGGC-TAC-	--AGCG--GC
	801				850
SEQ ID NO:83	CAAGGTC TTT	GACTTCCC GC	TCTACTACA A	GATGGACGAA	GCCTTCGACA
SEQ ID NO:85	CAAGGTC TTT	GACTTCCC GC	TCTACTACA A	GATGGACGAA	GCCTTCGACA
SEQ ID NO:75	CAAGGTC TTT	GACTTCGC CC	TCTACTACA A	GATGGACGAG	GCCTTCGATA
SEQ ID NO:77	CAAGGTC TTT	GACTTCGC CC	TCTACTACA A	GATGGACGAG	GCCTTCGATA
SEQ ID NO:73	TAAAGTC TTC	GACTTCCC GC	TCTACTACA A	GATGGACGAG	GCCTTCGATA
SEQ ID NO:79	AAAAGTC TTC	GACTTCCC GC	TCTACTACA A	GATGGACGCG	GCCTTTGACA
SEQ ID NO:81	CAAGGTC TTC	GACTTCCC GC	TCTACTACA A	GATGGATGAG	GCCTTTGACA
CLONE A (SEQ ID NO:320)	CAAGGTC TTC	GACTTCCC GC	TCTACTACA A	GATGGACGAG	GCCTTTGACA
Consensus (SEQ ID NO:321)	-AA-GTC TT-	GACTTC-C -C	TCTACTACA A	GATGGA-G -	GCCTT-GA-A
	851				900
SEQ ID NO:83	ACACCAA CAT	CCCCGCAT TA	GTGGATGCA C	TCAGATACGG	CCAGACAGTG
SEQ ID NO:85	ATACCAA CAT	CCCCGCTT TG	GTTTACGCC C	TCAAGAATGG	CGGGACAGTG
SEQ ID NO:75	ACAACAA CAT	TCCCGCCC TG	GTGGACGCC C	TCAGATACGG	CCAGACAGTG
SEQ ID NO:77	ACAACAA CAT	TCCCGCCC TG	GTGGACGCC C	TCAGATACGG	TCAGACAGTG
SEQ ID NO:73	ACAACAA CAT	CCCCGCCC TC	GTGGACGCC C	TCAAGAACGG	AGGCACGGTC
SEQ ID NO:79	ACAAGAA CAT	TCCCGCAC TC	GTCGAGGCC C	TCAAGAACGG	GGGCACAGTC
SEQ ID NO:81	ACAAAAA CAT	TCCAGCGC TC	GTCTCTGCC C	TTCAGAACGG	CCAGACTGTT
CLONE A (SEQ ID NO:320)	ACAAGAA CAT	TCCCGCCC TC	GTTTACGCC A	TCCAGAACGG	TGAAACCGTC
Consensus (SEQ ID NO:321)	A-A--AA CAT	-CC-GC-- T-	GT----GC- -	T-----A-GG	----AC-GT-
	901				950
SEQ ID NO:83	GTCAGCC GCG	ATCCCTTC AA	GGCGGTAAC T	TTCGTTGCCA	ACCACGATAC
SEQ ID NO:85	GTCAGCC GCG	ATCCCTTC AA	GGCGGTAAC T	TTCGTTGCCA	ACCACGATAC
SEQ ID NO:75	GTCAGCC GCG	ATCCCTTC AA	GGCTGTGAC G	TTTGTAGCCA	ACCACGATAC
SEQ ID NO:77	GTCAGCC GCG	ATCCCTTC AA	GGCTGTGAC G	TTTGTAGCCA	ACCACGATAC
SEQ ID NO:73	GTCAGCC GCG	ATCCCTTC AA	AGCCGTGAC C	TTCGTTGCCA	ACCACGATAC
SEQ ID NO:79	GTCAGCC GCG	ATCCCTTT AA	GGCCGTAAC C	TTCGTTGCAA	ACCACGACAC
SEQ ID NO:81	GTCTCCC GCG	ATCCCTTC AA	GGCCGTAAC C	TTTGTAGCAA	ACCACGACAC
CLONE A (SEQ ID NO:320)	GTCAGCA GGG	ATCCCTTC AA	GGCCGTTAC C	TTCGTGGCTA	ACCACGATAC
Consensus (SEQ ID NO:321)	GTC--C- G-G	A-CC-TT- AA	-GC-GT-AC -	TT-GT-GC-A	ACCACGA-AC
	951				1000
SEQ ID NO:83	AGATATA ATC	TGGAACAA GT	ATCCGGCTT A	TGCATTTCATC	CTTACCTATG
SEQ ID NO:85	AGATATA ATC	TGGAACAA GT	ATCCGGCTT A	TGCATTTCATC	CTTACCTATG
SEQ ID NO:75	CGACATA ATC	TGGAACAA GT	ATCCAGCCT A	CGCGTTTCATC	CTCACCTACG
SEQ ID NO:77	CGACATA ATC	TGGAACAA GT	ATCCAGCCT A	CGCGTTTCATC	CTCACCTACG
SEQ ID NO:73	CAACATA ATC	TGGAACAA GT	ATCCGGCCT A	CGCCTTCATC	CTCACCTATG
SEQ ID NO:79	GGACATA ATT	TGGAACAA GT	ATCCGGCCT A	CGCCTTCATC	CTCACCTACG
SEQ ID NO:81	CGATATA ATC	TGGAACAA GT	ACCTTGCTT A	TGCTTTCATC	CTCACCTACG
CLONE A (SEQ ID NO:320)	GAACATA ATC	TGGAACAA GT	ACCTTGCTT A	TGCCTTCATC	CTGACCTACG
Consensus (SEQ ID NO:321)	--A-ATA AT-	TGGAACAA GT	A-C--GC-TA	-GC-TTCATC	CT-ACCTA-G

Figure 14C-4



	1001		1050
SEQ ID NO:83	AGGGACA GCC TGTTATAT TC TACCGCGAC T ACGAGGAGTG GCTCAACAAG		
SEQ ID NO:85	AGGGACA GCC TGTTATAT TC TACCGCGAC T ACGAGGAGTG GCTCAACAAG		
SEQ ID NO:75	AGGGCCA GCC GACAATAT TC TACCGCGAC T ACGAGGAGTG GCTCAACAAG		
SEQ ID NO:77	AGGGCCA GCC GACAATAT TC TACCGCGAC T ACGAGGAGTG GCTCAACAAG		
SEQ ID NO:73	AGGGACA GCC GGCAATAT TC TACCGCGAC T ACGAGGAGTG GCTCAACAAG		
SEQ ID NO:79	AGGGCCA GCC GACGATAT TC TACCGCGAC T ACGAGGAGTG GCTCAACAAG		
SEQ ID NO:81	AAGGCCA GCC CGTCATAT TT TACCGCGAC T ACGAGGAGTG GCTCAACAAG		
CLONE A (SEQ ID NO:320)	AAGGTCA GCC CGTCATCT TC TACCGCGAC T ACGAGGAGTG GCTCAACAAG		
Consensus (SEQ ID NO:321)	A-GG-CA-GCC ----AT-TT- TACCGCGAC T ACGAGGAGTG GCTCAACAAG		
	1051		1100
SEQ ID NO:83	GATAAGC TTA ACAACCTC AT CTGGATACA C GATCACCTTG CTGGAGGGAG		
SEQ ID NO:85	GATAAGC TTA ACAACCTC AT CTGGATACA C GATCACCTTG CTGGAGGGAG		
SEQ ID NO:75	GACAAGC TCA AGAACCTC AT CTGGATACA T GACAACCTCG CCGAGGGGAG		
SEQ ID NO:77	GATAAGC TCA AGAACCTC AT CTGGATACA T GACAACCTCG CCGAGGGGAG		
SEQ ID NO:73	GACAGGC TCA GGAACCTC AT CTGGATACA C GACCACCTCG CCGGAGGAAG		
SEQ ID NO:79	GACAGGC TCA AGAACCTC AT CTGGATACA C GACCACCTCG CCGGTGGAAG		
SEQ ID NO:81	GACAGGT TGA ACAACCTC AT ATGGATACA C GACCACCTCG CAGGTGGAAG		
CLONE A (SEQ ID NO:320)	GACAAAC TCA ACAACCTC AT ATGGATTCA C GAGCACCTGG CAGGGGGAAG		
Consensus (SEQ ID NO:321)	GA-A---T-A --AACCTCAT -TGGAT-CA- GA--ACCT-G C-GG-GG-AG		
	1101		1150
SEQ ID NO:83	TACTGAC ATT GTTTACTA CG ACAGCGACG A GCTTATCTTT GTGAGAAACG		
SEQ ID NO:85	TACTGAC ATT GTTTACTA CG ACAGCGACG A GCTTATCTTT GTGAGAAACG		
SEQ ID NO:75	CACTGAC ATC GTTTACTA CG ACAACGACG A GCTGATATTC GTGAGAAACG		
SEQ ID NO:77	CACTGAC ATC GTTTACTA CG ACAACGACG A GCTGATATTC GTGAGAAACG		
SEQ ID NO:73	CACAGAC ATC ATCTACTA CG ACAGCGACG A GCTTATCTTC GTGAGAAACG		
SEQ ID NO:79	CACCGAC ATA GTCTACTA CG ATAACGATG A ACTCATCTTC GTCAGGAACG		
SEQ ID NO:81	CACGAGC ATA GTTTACTA CG ACAGCGACG A GATGATTTTC GTGAGGAACG		
CLONE A (SEQ ID NO:320)	CACCAAG ATC CTCTACTA CG ACGACGATG A GCTCATCTTC ATGAGGGAAG		
Consensus (SEQ ID NO:321)	-AC-----AT- -T-TACTA CG A---CGA-GA --T-AT-TT- -T-AG--A-G		
	1151		1200
SEQ ID NO:83	GCTATGG CAC CAAACCAG GA CTGATAACC T ATATCAACCT CGGCTCAAGC		
SEQ ID NO:85	GCTATGG CAC CAAACCAG GA CTGATAACC T ATATCAACCT CGGCTCAAGC		
SEQ ID NO:75	GCTACGG AAG CAAGCCGG GA CTGATAACA T ACATCAACCT CGGCTCAAGC		
SEQ ID NO:77	GCTACGG AAG CAAGCCGG GA CTGATAACA T ACATCAACCT CGCCTCAAGC		
SEQ ID NO:73	GCTACGG GGA CAAGCCGG GA CTGATAACC T ACATCAACCT CGGCTCAAGC		
SEQ ID NO:79	GCTACGG GGA CAAGCCGG GG CTTATAACC T ACATCAACCT AGGCTCGAGC		
SEQ ID NO:81	GCTATGG AAG CAAGCCTG GC CTTATAACT T ACATCAACCT CGGCTCGAGC		
CLONE A (SEQ ID NO:320)	GCTACGG CGA CAGGCCGG GG CTTATAACC T ACATCAACCT CGGTAGCGAC		
Consensus (SEQ ID NO:321)	GCTA-GG --- CA--CC-GG- CT-ATAAC- T A-ATCAACCT -G-----C		
	1201		1250
SEQ ID NO:83	AAAGTTG GAA GGTGGGTC TA CGTT...CCA AAGTTCGCCG GTTCATGCAT		
SEQ ID NO:85	AAAGCTG GAA GGTGGGTC TA CGTT...CCA AAGTTCGCCG GTTCATGCAT		
SEQ ID NO:75	AAAGCCG GAA GGTGGGTT TA CGTT...CCG AAGTTCGCAG GCTCGTGAT		
SEQ ID NO:77	AAAGCCG GAA GGTGGGTT TA CGTT...CCG AAGTTCGCAG GCTCGTGAT		
SEQ ID NO:73	AAGGCCG GAA GGTGGGTC TA CGTT...CCG AAGTTCGCAG GCTCGTGAT		
SEQ ID NO:79	AAGGCCG GGA GGTGGGTC TA CGTT...CCG AAGTTCGCCG GAGCGTGAT		
SEQ ID NO:81	AAGGTTG GAA GGTGGGTT TA TGTG...CCG AAGTTCGCCG GCGCGTGAT		
CLONE A (SEQ ID NO:320)	TGGGCCG AGA GATGGGTG AA CGTTGGCTC A AAGTTCGCCG GCTATACAAT		
Consensus (SEQ ID NO:321)	---G--G--A G-TGGGT--A -GT-----C AAGTTCGC-G G-----AT		

Figure 14C-5



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Applicant(s): Walter Callen et al.

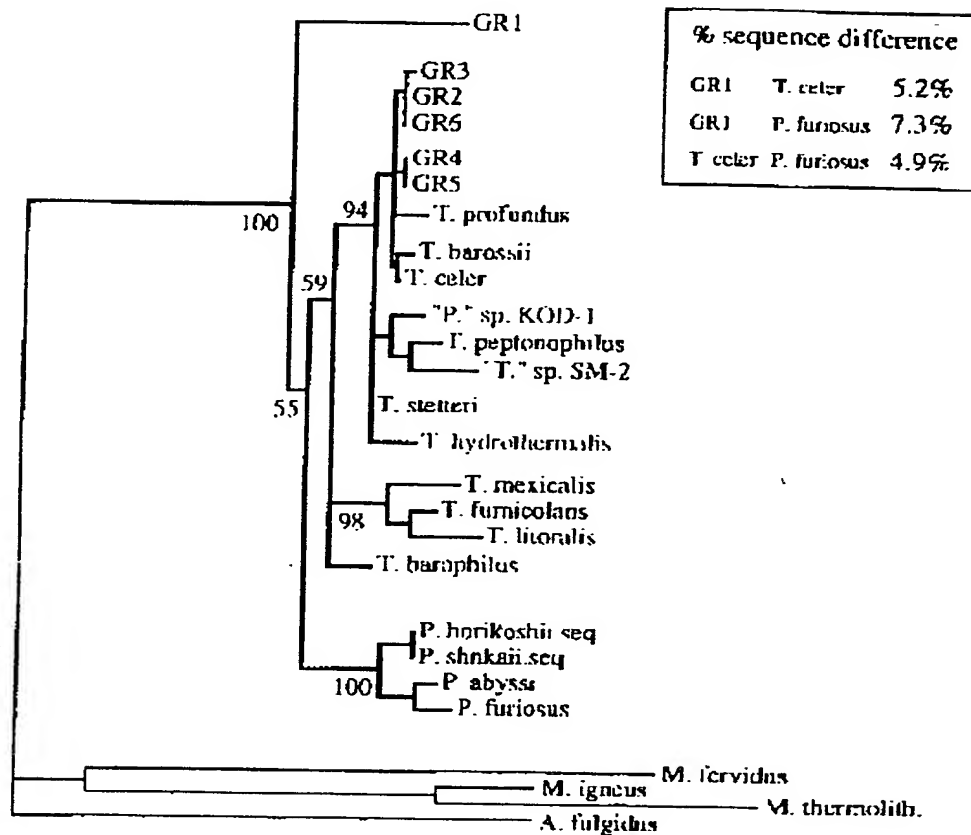
ENZYMES HAVING ALPHA AMYLASE ACTIVITY AND  
METHODS OF USE THEREOF

	1251		1300
SEQ ID NO:83	CCACGAG TAC ACCGGCAA CC TCGGCGGT G GATAGACAAG TACGTCTCCT		
SEQ ID NO:85	CCACGAG TAC ACCGGCAG CC TCGGCGGT G GATAGACAAG TACGTCTCCT		
SEQ ID NO:75	ACACGAG TAC ACCGGCAA CC TCGGCGGT G GGTGACAAG TGGGTGGACT		
SEQ ID NO:77	ACACGAG TAC ACCGGCAA TC TCGGCGGT G GGTGACAAG TGGGTGGACT		
SEQ ID NO:73	ACACGAG TAC ACCGGCAA CC TCGGCGGT G GATTGACAAG TGGGTGGACT		
SEQ ID NO:79	CCACGAG TAC ACCGGCAA CC TCGGCGGT G GGTGACAAG TGGGTGGACT		
SEQ ID NO:81	CCACGAG TAT ACTGGTAA CC TCGGAGGT G GGTAGACAAG TACGTCTACT		
CLONE A (SEQ ID NO:320)	CCACGAA TAC ACCGGAAA CC TCGGCGGT G GGTGACAGG TACGTCCAGT		
Consensus (SEQ ID NO:321)	-CACGA- TA- AC-GG-A- -C TCGG-GG-T G G-T-GACA-G T--GT----T		
	1301		1350
SEQ ID NO:83	CCAGCGG CTG GGTCTATC TT GAGGCCCG C CCCACGACCC GGCGAACGGC		
SEQ ID NO:85	CCAGCGG CTG GGTCTACC TT GAGGCCCG G CCCACGACCC GGCCAATGGC		
SEQ ID NO:75	CAAGCGG CTG GGTTTACC TC GAGGCTCCT G CCCACGACCC GGCCAACGGC		
SEQ ID NO:77	CAAGCGG CTG GGTCTACC TC GAGGCTCCT G CCCACGACCC GGCCAACGGC		
SEQ ID NO:73	CAAGCGG TCG GGTCTACC TT GAGGCCCG C CCCACGACCC GGCCAACGGC		
SEQ ID NO:79	CAAGCGG GTG GGTGTACC TC GAGGCCCT G CCCACGACCC GGCCAACGGC		
SEQ ID NO:81	CAAGCGG CTG GGTCTATT TC GAAGCTCCA G CTTACGACCC TGCCAACGGG		
CLONE A (SEQ ID NO:320)	ACGACGG CTG GGTCAAGC TT ACCGCTCCG C CACACGATCC GGCAAACGGC		
Consensus (SEQ ID NO:321)	----CGG--G GGT--A--T- ---GC-CC-- C--ACGA-CC -GC-AA-GG-		
	1351		1393
SEQ ID NO:83	TACTACG GCT ACTCCGTA TG GAGCTACTG C GGGGTTGGGT GA~		
SEQ ID NO:85	CAGTATG GCT ACTCCGTC TG GAGCTATTG C GGGGTTGGGT GA~		
SEQ ID NO:75	CAGTACG GCT ACTCCGTT TG GAGCTATTG C GGTGTTGGGT GA~		
SEQ ID NO:77	CAGTACG GCT ACTCCGTC TG GAGCTACTG C GGTGTTGGGT GA~		
SEQ ID NO:73	CAGTACG GCT ACTCCGTA TG GAGCTACTG C GGTGTTGGGT GA~		
SEQ ID NO:79	TATTACG GCT ACTCCGTC TG GAGCTACTG C GGGGTGGGCT GA~		
SEQ ID NO:81	CAGTATG GCT ACTCCGTG TG GAGCTATTG C GGTGTTGGGT GA~		
CLONE A (SEQ ID NO:320)	TATTACG GCT ACTCCGTC TG GAGCTACGC C GGAGTTGGAT GA~		
Consensus (SEQ ID NO:321)	-A-TA-G GCT ACTC-GT- TG GAGCTA--- C GG-GT-GG-T GA~		

Figure 14C-6



### Neighbor-joining tree for Thermococcales



0.01  
bootstrap values for 100 replicates

Sutcliffe & Barnes, Deep-Sea Research Pt. II, in press

### Figure 15



SEQ ID NO.: 1

atggcaaagtattccgagctcgaagagggcgggctcataatgcaggccttctactgggacgtcccatgggaggaatctggtgggacacgat  
agcccagaagatacccgcactgggcaagcgccgggatttcggcgatatggattccccggcgagcaagggcatggcgccgcctattcga  
ggctacgacccctacgacttcttgacctcggtagtacgaccagaagggaaacggtagagacgcgcttggctccaagcaggagctcgtgaa  
catgataaacaccgcccacgcctatggcatgaaggtaatagccgatatagtcatcaaccaccgcgcggcggtgacctggagtgaacccctt  
cgtgaacgactatacctggaccgacttctcaaaaggtcgcgtcgggtaaatacacggccaactacctcgacttccaccgaacgagctccatgc  
ggcgattccggaacatttggaggctatcccgcacatatgccacgacaagagctgggaccagtactggctctgggccagccaggagagctac  
gcggcatatctcaggagcatcggcatcgtcctggcgcttcgactacgtcaagggtactcggagcgtgggtcgtcaaggactggctggactg  
gtggggaggctgggcccgtcggggagtactgggacacaaacgttgatgcactgtcaactgggctactcagcgatgcaaaagtcttcgactt  
cccgtctactacaagatggacgcggccttggacaacaagaacattcccgcactcgtcaggccctcaagaacgggggcacagctcgcagcc  
gcgacccgtttaaggccgtaaccttctgtgcaaacacgacaccgatataatctggaacaagtatccagcctacgcgttcacctcacctacgag  
ggccagccgacaatattctaccgcgactacgaggagtggctcaacaaggataagctcaagaacctcatctggatacatgacaacctcgcgg  
aggaagcactgacatcgtttactacgacaacgacgagctgatattcgtgagaacggctacggaagcaagccgggactgataacatacatcaa  
cctcgcctcaagcaaacgggaaggtgggtttacgttcggaagttcgcaggctcgtgcatacacgagtacaccggcaatctcggcggtgggt  
ggacaagtgggtgactcaagcggtgggtctacctcagggtcctgcccacgacccggccaacggccagtacggctactcgtctggagc  
tactcggtgttgggtga

SEQ ID NO.: 2

Met Ala Lys Tyr Ser Glu Leu Glu Gly Gly Leu Ile Met Gln Ala Phe Tyr Trp Asp Val Pro Met  
Gly Gly Ile Trp Trp Asp Thr Ile Ala Gln Lys Ile Pro Asp Trp Ala Ser Ala Gly Ile Ser Ala Ile Trp  
Ile Pro Pro Ala Ser Lys Gly Met Gly Gly Ala Tyr Ser Met Gly Tyr Asp Pro Tyr Asp Phe Phe Asp  
Leu Gly Glu Tyr Asp Gln Lys Gly Thr Val Glu Thr Arg Phe Gly Ser Lys Gln Glu Leu Val Asn  
Met Ile Asn Thr Ala His Ala Tyr Gly Met Lys Val Ile Ala Asp Ile Val Ile Asn His Arg Ala Gly Gly  
Asp Leu Glu Trp Asn Pro Phe Val Asn Asp Tyr Thr Trp Thr Asp Phe Ser Lys Val Ala Ser Gly Lys  
Tyr Thr Ala Asn Tyr Leu Asp Phe His Pro Asn Glu Leu His Ala Gly Asp Ser Gly Thr Phe Gly Gly  
Tyr Pro Asp Ile Cys His Asp Lys Ser Trp Asp Gln Tyr Trp Leu Trp Ala Ser Gln Glu Ser Tyr Ala  
Ala Tyr Leu Arg Ser Ile Gly Ile Asp Ala Trp Arg Phe Asp Tyr Val Lys Gly Tyr Gly Ala Trp Val  
Val Lys Asp Trp Leu Asp Trp Trp Gly Gly Trp Ala Val Gly Glu Tyr Trp Asp Thr Asn Val Asp Ala  
Leu Leu Asn Trp Ala Tyr Ser Ser Asp Ala Lys Val Phe Asp Phe Pro Leu Tyr Tyr Lys Met Asp Ala  
Ala Phe Asp Asn Lys Asn Ile Pro Ala Leu Val Glu Ala Leu Lys Asn Gly Gly Thr Val Val Ser Arg  
Asp Pro Phe Lys Ala Val Thr Phe Val Ala Asn His Asp Thr Asp Ile Ile Trp Asn Lys Tyr Pro Ala  
Tyr Ala Phe Ile Leu Thr Tyr Glu Gly Gln Pro Thr Ile Phe Tyr Arg Asp Tyr Glu Glu Trp Leu Asn  
Lys Asp Lys Leu Lys Asn Leu Ile Trp Ile His Asp Asn Leu Ala Gly Gly Ser Thr Asp Ile Val Tyr  
Tyr Asp Asn Asp Glu Leu Ile Phe Val Arg Asn Gly Tyr Gly Ser Lys Pro Gly Leu Ile Thr Tyr Ile  
Asn Leu Ala Ser Ser Lys Ala Gly Arg Trp Val Tyr Val Pro Lys Phe Ala Gly Ser Cys Ile His Glu  
Tyr Thr Gly Asn Leu Gly Gly Trp Val Asp Lys Trp Val Asp Ser Ser Gly Trp Val Tyr Leu Glu Ala  
Pro Ala His Asp Pro Ala Asn Gly Gln Tyr Gly Tyr Ser Val Trp Ser Tyr Cys Gly Val Gly

SEQ ID NO.: 3

atggccaagtacctggagctcgaagagggcgggctcataatgcaggccttctactgggacgtcccatgggaggaatctggtgggacacgat  
agcccagaagatacccgcactgggcaagcgccgggatttcggcgatatggattccccggcgagcaagggcatggcgccgcctattcga  
ggctacgacccctacgacttcttgacctcggtagtacgaccagaagggaaacggtagagacgcgcttggctccaagcaggagctcgtgaa  
catgataaacaccgcccacgcctacggcatcaaggctcgcagacatagtaataaccaccgcgcggaggagaccttgagtgaacccct  
tcgtcaatgactacacctggacgggacttctgaaggtcgttcggcaagtagacggccaattacctcgacttccaccgaacgagctccatgc  
ggcgattccggaacatttggaggctatcccgcacatatgccacgacaagagctgggaccagtactggctctgggccagccaggagagctac  
gcggcatatctcaggagcatcggcatcgtcctggcgcttcgactacgtcaagggtatgctcctgggtcgtcaaggactggctgaactggt  
ggggaggctggcggttggagagtactgggacaccaacgtcagcgtgttctcaactgggcatactcagcgggtgccaaggtctttgacttcg  
ccctctactacaagatggatgaggccttggacaacaaaacattccagcgtcgtctcgtccctcagaacggccagactgtgtctccgcgac  
ccgttcaaggccgtaacctttagtgaacaccacgacaccgatataatctggaacaagtatccagcctacgcgttcacctcacctacgaggggcc

Figure 16A



gcccgaacaatttctaccgcgactacgaggagtggctcaacaaggataagctcaagaacctcatctggatacatgacaacctcgccggagga  
agcactgacatcggttactacgacaacgacgagctgatattcgtgagaacggctacggaagcaagccgggactgataacatacatcaacctc  
gcctcaagcgaagccggaaggtgggtctacgttccgaagttcgccggagcgtgcatccacgagtagaccggcaacctcgccgggtgggtgg  
acaagtgggtggactcaagcgggtgggtgtacctcgaggccctgcccacgacccggccaacggctattacggctactccgtctggagctatt  
gcgggtgtgggtga

SEQ ID NO.: 4

Met Ala Lys Tyr Leu Glu Leu Glu Gly Gly Leu Ile Met Gln Ala Phe Tyr Trp Asp Val Pro Met  
Gly Gly Ile Trp Trp Asp Thr Ile Ala Gln Lys Ile Pro Asp Trp Ala Ser Ala Gly Ile Ser Ala Ile Trp  
Ile Pro Pro Ala Ser Lys Gly Met Gly Gly Ala Tyr Ser Met Gly Tyr Asp Pro Tyr Asp Phe Phe Asp  
Leu Gly Glu Tyr Asp Gln Lys Gly Thr Val Glu Thr Arg Phe Gly Ser Lys Gln Glu Leu Val Asn  
Met Ile Asn Thr Ala His Ala Tyr Gly Ile Lys Val Ile Ala Asp Ile Val Ile Asn His Arg Ala Gly Gly  
Asp Leu Glu Trp Asn Pro Phe Val Asn Asp Tyr Thr Trp Thr Asp Phe Ser Lys Val Ala Ser Gly Lys  
Tyr Thr Ala Asn Tyr Leu Asp Phe His Pro Asn Glu Leu His Ala Gly Asp Ser Gly Thr Phe Gly Gly  
Tyr Pro Asp Ile Cys His Asp Lys Ser Trp Asp Gln Tyr Trp Leu Trp Ala Ser Gln Glu Ser Tyr Ala  
Ala Tyr Leu Arg Ser Ile Gly Ile Asp Ala Trp Arg Phe Asp Tyr Val Lys Gly Tyr Ala Pro Trp Val  
Val Lys Asp Trp Leu Asn Trp Trp Gly Gly Trp Ala Val Gly Glu Tyr Trp Asp Thr Asn Val Asp Ala  
Val Leu Asn Trp Ala Tyr Ser Ser Gly Ala Lys Val Phe Asp Phe Ala Leu Tyr Tyr Lys Met Asp Glu  
Ala Phe Asp Asn Lys Asn Ile Pro Ala Leu Val Ser Ala Leu Gln Asn Gly Gln Thr Val Val Ser Arg  
Asp Pro Phe Lys Ala Val Thr Phe Val Ala Asn His Asp Thr Asp Ile Ile Trp Asn Lys Tyr Pro Ala  
Tyr Ala Phe Ile Leu Thr Tyr Glu Gly Gln Pro Thr Ile Phe Tyr Arg Asp Tyr Glu Glu Trp Leu Asn  
Lys Asp Lys Leu Lys Asn Leu Ile Trp Ile His Asp Asn Leu Ala Gly Gly Ser Thr Asp Ile Val Tyr  
Tyr Asp Asn Asp Glu Leu Ile Phe Val Arg Asn Gly Tyr Gly Ser Lys Pro Gly Leu Ile Thr Tyr Ile  
Asn Leu Ala Ser Ser Glu Ala Gly Arg Trp Val Tyr Val Pro Lys Phe Ala Gly Ala Cys Ile His Glu  
Tyr Thr Gly Asn Leu Gly Gly Trp Val Asp Lys Trp Val Asp Ser Ser Gly Trp Val Tyr Leu Glu Ala  
Pro Ala His Asp Pro Ala Asn Gly Tyr Tyr Gly Tyr Ser Val Trp Ser Tyr Cys Gly Val Gly

SEQ ID NO.: 5

atggccaagtactccgagctggaagagggcgcggtataatgcaggccttactgggacgtcccaggtggaggaatctggtgggacacat  
caggagcaagataccggagtggtacgaggcggaatatccgccatttggattcccccggaagcaagggcatgggcggcgcttattcgtatg  
ggctacgacccctacgactctttgacctcgggtgagtagcaccagaaggggaacggtagagacgcgcttgggtccaagcaggagctcgtgaa  
catgataaacaccgcccacgcctatggcatgaaggaatagccgatatagtcatcaaccaccgcgccggcggtgacctggagtgaacccct  
cgtgaacgactatacctggaccgacttctcaaaggtcgcgtcggtgaaatacacggccaactacctcgacttcccccgaacgagctccatgc  
ggcggtatccggaacatttggaggctatcccgacatatgccagacaagagctgggaccagtactggctctggccagccaggagagctac  
gcggcatactcaggagcatcggcatcgatgcctggcgcttcgactacgtcaagggtatgctccctgggtcgtcaaggactggctgaactgg  
ggggaggctggcggttggagagtactgggacaccaacgtcgacgctgttctcaactgggcatactcagcgggtgccaaggtcttgcattcg  
ccctctactacaagatggatgaggcctttgacaacaaaacattccagcgctcgtctctgcccttcagaacggccagactgttctccccgcgac  
ccgttcaaggccgtaaccttttagcaaacacgacaccgataataatggaacaagtaccttgcttatgctttcatctcactcaagggccag  
cccgctatattctaccgcgaccacgaggagtggctcaacaaggacaggtgaacaacctcatatggatacacgaccacctcgaggtggaag  
caccgacatagtctactacgataacgatgaactcatctcgcaggaacggctacggggacaagccggggctataacctacatcaacctagggc  
tcgagcaaggccggaaggtgggtttatgtgccgaagttcgccggcgctgcattccacgagtatactgtaacctcggaggctgggtagacaa  
gtacgtctactcaagcggtgggtctatctcgaagctccagcttacgacctgccaacgggcagtatggctactccgtgtggagctactgcggg  
gtgggctga

SEQ ID NO.: 6

Met Ala Lys Tyr Ser Glu Leu Glu Glu Gly Gly Val Ile Met Gln Ala Phe Tyr Trp Asp Val Pro Gly  
Gly Gly Ile Trp Trp Asp Thr Ile Arg Ser Lys Ile Pro Glu Trp Tyr Glu Ala Gly Ile Ser Ala Ile Trp  
Ile Pro Pro Ala Ser Lys Gly Met Gly Gly Ala Tyr Ser Met Gly Tyr Asp Pro Tyr Asp Phe Phe Asp  
Leu Gly Glu Tyr Asp Gln Lys Gly Thr Val Glu Thr Arg Phe Gly Ser Lys Gln Glu Leu Val Asn  
Met Ile Asn Thr Ala His Ala Tyr Gly Met Lys Val Ile Ala Asp Ile Val Ile Asn His Arg Ala Gly Gly

Figure 16B



Asp Leu Glu Trp Asn Pro Phe Val Asn Asp Tyr Thr Trp Thr Asp Phe Ser Lys Val Ala Ser Gly Lys  
Tyr Thr Ala Asn Tyr Leu Asp Phe His Pro Asn Glu Leu His Ala Gly Asp Ser Gly Thr Phe Gly Gly  
Tyr Pro Asp Ile Cys His Asp Lys Ser Trp Asp Gln Tyr Trp Leu Trp Ala Ser Gln Glu Ser Tyr Ala  
Ala Tyr Leu Arg Ser Ile Gly Ile Asp Ala Trp Arg Phe Asp Tyr Val Lys Gly Tyr Ala Pro Trp Val  
Val Lys Asp Trp Leu Asn Trp Trp Gly Gly Trp Ala Val Gly Glu Tyr Trp Asp Thr Asn Val Asp Ala  
Val Leu Asn Trp Ala Tyr Ser Ser Gly Ala Lys Val Phe Asp Phe Ala Leu Tyr Tyr Lys Met Asp Glu  
Ala Phe Asp Asn Lys Asn Ile Pro Ala Leu Val Ser Ala Leu Gln Asn Gly Gln Thr Val Val Ser Arg  
Asp Pro Phe Lys Ala Val Thr Phe Val Ala Asn His Asp Thr Asp Ile Ile Trp Asn Lys Tyr Leu Ala  
Tyr Ala Phe Ile Leu Thr Tyr Glu Gly Gln Pro Val Ile Phe Tyr Arg Asp His Glu Glu Trp Leu Asn  
Lys Asp Arg Leu Asn Asn Leu Ile Trp Ile His Asp His Leu Ala Gly Gly Ser Thr Asp Ile Val Tyr  
Tyr Asp Asn Asp Glu Leu Ile Phe Val Arg Asn Gly Tyr Gly Asp Lys Pro Gly Leu Ile Thr Tyr Ile  
Asn Leu Gly Ser Ser Lys Ala Gly Arg Trp Val Tyr Val Pro Lys Phe Ala Gly Ala Cys Ile His Glu  
Tyr Thr Gly Asn Leu Gly Gly Trp Val Asp Lys Tyr Val Tyr Ser Ser Gly Trp Val Tyr Leu Glu Ala  
Pro Ala Tyr Asp Pro Ala Asn Gly Gln Tyr Gly Tyr Ser Val Trp Ser Tyr Cys Gly Val Gly

SEQ ID NO.: 9

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ggctacgacccctacgacttctttgacctcgggtgagtagcagaccagaaggggaacggtagagacgcgctttggtccaagcaggagctcgtgaa  
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ttcgttggggactacacctggacggacttctcaaaggtggcctcgggcaaatatactgccaactacctcgaactccacccgaacgagctccatg  
cgggcgattccggaacatttggaggctatcccagacatattccacgacaagagctgggaccagtactggctctgggcccagccaggagagctac  
gcggcatactcaggagcatcggcatcgtatgctggcgcttcgactacgtcaagggctatgctccctgggtcgtcaaggactggctgaactggt  
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cccttactacaagatggacgaggccttcgataacaacaacattcccgccttggtggacgccctcagatacggtcagacagtggtcagccgcg  
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cagccgacaataattctaccgcgactacgaggagtggctcaacaaggataagctcaagaacctcatctggatacatgacaacctcgcggagg  
aagcactgacatcgtttactacgacaacgacgagctgatattcgcgagaacgggtacggaagcaagccgggactgataacatacatcaacct  
cgctcaagcaaagccggaaggtgggtttacgttcggaagttcgaggctcgtgcatacacgagtagaccggcaatctcggcggttggtgg  
acaagtgggtgactcaagcgggtgggtctacctcagggctcctgccacgacccggccaacggccagtagcgtactccgtctggagctac  
tgcggtgttgggtga

SEQ ID NO.: 10

Met Ala Lys Tyr Ser Glu Leu Glu Glu Gly Gly Leu Ile Met Gln Ala Phe Tyr Trp Asp Val Pro Met  
Gly Gly Ile Trp Trp Asp Thr Ile Ala Gln Lys Ile Pro Asp Trp Ala Ser Ala Gly Ile Ser Ala Ile Trp  
Ile Pro Pro Ala Ser Lys Gly Met Gly Gly Ala Tyr Ser Met Gly Tyr Asp Pro Tyr Asp Phe Phe Asp  
Leu Gly Glu Tyr Asp Gln Lys Gly Thr Val Glu Thr Arg Phe Gly Ser Lys Gln Glu Leu Val Asn  
Met Ile Asn Thr Ala His Ala Tyr Gly Ile Lys Val Ile Ala Asp Ile Val Ile Asn His Arg Ala Gly Gly  
Asp Leu Glu Trp Asn Pro Phe Val Gly Asp Tyr Thr Trp Thr Asp Phe Ser Lys Val Ala Ser Gly Lys  
Tyr Thr Ala Asn Tyr Leu Asp Phe His Pro Asn Glu Leu His Ala Gly Asp Ser Gly Thr Phe Gly Gly  
Tyr Pro Asp Ile Cys His Asp Lys Ser Trp Asp Gln Tyr Trp Leu Trp Ala Ser Gln Glu Ser Tyr Ala  
Ala Tyr Leu Arg Ser Ile Gly Ile Asp Ala Trp Arg Phe Asp Tyr Val Lys Gly Tyr Ala Pro Trp Val  
Val Lys Asp Trp Leu Asn Trp Trp Gly Gly Trp Ala Val Gly Glu Tyr Trp Asp Thr Asn Val Asp Ala  
Val Leu Asn Trp Ala Tyr Ser Ser Gly Ala Lys Val Phe Asp Phe Ala Leu Tyr Tyr Lys Met Asp Glu  
Ala Phe Asp Asn Asn Asn Ile Pro Ala Leu Val Asp Ala Leu Arg Tyr Gly Gln Thr Val Val Ser Arg  
Asp Pro Phe Lys Ala Val Thr Phe Val Ala Asn His Asp Thr Asp Ile Ile Trp Asn Lys Tyr Pro Ala  
Tyr Ala Phe Ile Leu Thr Tyr Glu Gly Gln Pro Thr Ile Phe Tyr Arg Asp Tyr Glu Glu Trp Leu Asn  
Lys Asp Lys Leu Lys Asn Leu Ile Trp Ile His Asp Asn Leu Ala Gly Gly Ser Thr Asp Ile Val Tyr  
Tyr Asp Asn Asp Glu Leu Ile Phe Ala Arg Asn Gly Tyr Gly Ser Lys Pro Gly Leu Ile Thr Tyr Ile  
Asn Leu Ala Ser Ser Lys Ala Gly Arg Trp Val Tyr Val Pro Lys Phe Ala Gly Ser Cys Ile His Glu

Figure 16C



Tyr Thr Gly Asn Leu Gly Gly Trp Val Asp Lys Trp Val Asp Ser Ser Gly Trp Val Tyr Leu Glu Ala  
Pro Ala His Asp Pro Ala Asn Gly Gln Tyr Gly Tyr Ser Val Trp Ser Tyr Cys Gly Val Gly

SEQ ID NO.: 11

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cgtgaacgactatacctggaccgacttctcaaggtcgcgctcggttaatacacggccaactacctgacttccacccgaacgagctccatgc  
ggcggtattccggaacatttggaggctatcccgcacatagccacgacaagagctgggaccagtactggctctggggcaccaggagagctac  
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cagccgacaatatctaccgcgactacgaggagtggctcaacaaggatacgtcaagaacctcatctggatacatgacaacctcgccggagg  
aagcacgagcatagtctactacgacagcgacgagatgatctcgtgaggaaacggctatggaagcaagcctggccttataacttacatcaacctc  
ggctcgagcaaggttgaaggtgggtctacgtccgaaggtcggggagcgtgcacccaggtacacccggcaacctcgccggctgggtg  
acaagtggtggactcaagcgggtgggtgtacctcgaggccccctgccacgacccggccaacggctattacggctactccgtctggagctac  
tgcggtgttgctga

SEQ ID NO.: 12

Met Ala Lys Tyr Leu Glu Leu Glu Gly Gly Leu Ile Met Gln Ala Phe Tyr Trp Asp Val Pro Met  
Gly Gly Ile Trp Trp Asp Thr Ile Ala Gln Lys Ile Pro Asp Trp Ala Ser Ala Gly Ile Ser Ala Ile Trp  
Ile Pro Pro Ala Ser Lys Gly Met Gly Gly Ala Tyr Ser Met Gly Tyr Asp Pro Tyr Asp Phe Phe Asp  
Leu Gly Glu Tyr Asp Gln Lys Gly Thr Val Glu Thr Arg Phe Gly Ser Lys Gln Glu Leu Val Asn  
Met Ile Asn Thr Ala His Ala Tyr Gly Met Lys Val Ile Ala Asp Ile Val Ile Asn His Arg Ala Gly Gly  
Asp Leu Glu Trp Asn Pro Phe Val Asn Asp Tyr Thr Trp Thr Asp Phe Ser Lys Val Ala Ser Gly Lys  
Tyr Thr Ala Asn Tyr Leu Asp Phe His Pro Asn Glu Leu His Ala Gly Asp Ser Gly Thr Phe Gly Gly  
Tyr Pro Asp Ile Cys His Asp Lys Ser Trp Asp Gln Tyr Trp Leu Trp Ala Ser Gln Glu Ser Tyr Ala  
Ala Tyr Leu Arg Ser Ile Gly Ile Asp Ala Trp Arg Phe Asp Tyr Val Lys Gly Tyr Ala Pro Trp Val  
Val Lys Asp Trp Leu Asn Trp Trp Gly Gly Trp Ala Val Gly Glu Tyr Trp Asp Thr Asn Val Asp Ala  
Val Leu Asn Trp Ala Tyr Ser Ser Gly Ala Lys Val Phe Asp Phe Ala Leu Tyr Tyr Lys Met Asp Glu  
Ala Phe Asp Asn Asn Asn Ile Pro Ala Leu Val Asp Ala Leu Arg Tyr Gly Gln Thr Val Val Ser Arg  
Asp Pro Phe Lys Ala Val Thr Phe Val Ala Asn His Asp Thr Asp Ile Ile Trp Asn Lys Tyr Pro Ala  
Tyr Ala Phe Ile Leu Thr Tyr Glu Gly Gln Pro Thr Ile Phe Tyr Arg Asp Tyr Glu Glu Trp Leu Asn  
Lys Asp Thr Leu Lys Asn Leu Ile Trp Ile His Asp Asn Leu Ala Gly Gly Ser Thr Ser Ile Val Tyr  
Tyr Asp Ser Asp Glu Met Ile Phe Val Arg Asn Gly Tyr Gly Ser Lys Pro Gly Leu Ile Thr Tyr Ile  
Asn Leu Gly Ser Ser Lys Val Gly Arg Trp Val Tyr Val Pro Lys Phe Ala Gly Ala Cys Ile His Glu  
Tyr Thr Gly Asn Leu Gly Gly Trp Val Asp Lys Trp Val Asp Ser Ser Gly Trp Val Tyr Leu Glu Ala  
Pro Ala His Asp Pro Ala Asn Gly Tyr Tyr Gly Tyr Ser Val Trp Ser Tyr Cys Gly Val Gly

SEQ ID NO.: 13

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ggctacgacccctacgacttcttgacctgggtgagtatgaccagaagggaacggtagagacgcgcttggctccaagcaggagctcgtgaac  
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gccgctacctaaaggagcatcggcggtgatgcctggcgcttcgactacgtcaagggtctacggagcgtgggtcgtaaggactggctggactg  
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Figure 16D



ccgctctactacaagatggatgaggccttgacaacaaaaacattccagcgctcgtctctgccctcagaacggccagactgtgtctcccgcg  
accggttcaaggccgtaaccttttagcaaaccacgacaccgatataatctggaacaagtatccagcctacgcgttcacctcacctacgaggg  
ccagccgacaatattctaccgcgactacgaggagtggctcaacaaggataagctcaagaacctcatctggatacatgacaacctcgccggag  
gaagcactgacatagctactacgataacgatgaactcatcttcgtaggaacggctacggggacaagccggggttataacctacatcaacct  
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cgggtgttgctga

SEQ ID NO.: 14

Met Ala Lys Tyr Leu Glu Leu Glu Gly Gly Val Ile Met Gln Ala Phe Tyr Trp Asp Val Pro Ser  
Gly Gly Ile Trp Trp Asp Thr Ile Arg Gln Lys Ile Pro Glu Trp Tyr Asp Ala Gly Ile Ser Ala Ile Trp  
Ile Pro Pro Ala Ser Lys Gly Met Gly Gly Ala Tyr Ser Met Gly Tyr Asp Pro Tyr Asp Phe Phe Asp  
Leu Gly Glu Tyr Asp Gln Lys Gly Thr Val Glu Thr Arg Phe Gly Ser Lys Gln Glu Leu Val Asn  
Met Ile Asn Thr Ala His Ala Tyr Gly Ile Lys Val Ile Ala Asp Ile Val Ile Asn His Arg Ala Gly Gly  
Asp Leu Glu Trp Asn Pro Phe Val Gly Asp Tyr Thr Trp Thr Asp Phe Ser Lys Val Ala Ser Gly Lys  
Tyr Thr Ala Asn Tyr Leu Asp Phe His Pro Asn Glu Val Lys Cys Cys Asp Glu Gly Thr Phe Gly  
Gly Phe Pro Asp Ile Ala His Glu Lys Ser Trp Asp Gln His Trp Leu Trp Ala Ser Asp Glu Ser Tyr  
Ala Ala Tyr Leu Arg Ser Ile Gly Val Asp Ala Trp Arg Phe Asp Tyr Val Lys Gly Tyr Gly Ala Trp  
Val Val Lys Asp Trp Leu Asp Trp Trp Gly Gly Trp Ala Val Gly Glu Tyr Trp Asp Thr Asn Val Asp  
Ala Leu Leu Asn Trp Ala Tyr Ser Ser Asp Ala Lys Val Phe Asp Phe Pro Leu Tyr Tyr Lys Met Asp  
Glu Ala Phe Asp Asn Lys Asn Ile Pro Ala Leu Val Ser Ala Leu Gln Asn Gly Gln Thr Val Val Ser  
Arg Asp Pro Phe Lys Ala Val Thr Phe Val Ala Asn His Asp Thr Asp Ile Ile Trp Asn Lys Tyr Pro  
Ala Tyr Ala Phe Ile Leu Thr Tyr Glu Gly Gln Pro Thr Ile Phe Tyr Arg Asp Tyr Glu Glu Trp Leu  
Asn Lys Asp Lys Leu Lys Asn Leu Ile Trp Ile His Asp Asn Leu Ala Gly Gly Ser Thr Asp Ile Val  
Tyr Tyr Asp Asn Asp Glu Leu Ile Phe Val Arg Asn Gly Tyr Gly Asp Lys Pro Gly Leu Ile Thr Tyr  
Ile Asn Leu Gly Ser Ser Lys Ala Gly Arg Trp Val Tyr Val Pro Lys Phe Ala Gly Ala Cys Ile His  
Glu Tyr Thr Gly Asn Leu Gly Gly Trp Val Asp Lys Tyr Val Tyr Ser Ser Gly Trp Val Tyr Leu Glu  
Ala Pro Ala Tyr Asp Pro Ala Asn Gly Gln Tyr Gly Tyr Ser Val Trp Ser Tyr Cys Gly Val Gly

SEQ ID NO.: 15

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ggctacgaccctacgacttctttgacctcggtagtacgaccagaagggaacggtagagacgcgtttggctccaagcaggagctcgtgaa  
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gaagcactgacatcgtttactacgacaacgacgagctgatattcgtgagaacggctacggaagcaagccgggactgataacatacatcaacc  
tcgctcaagcaagccggaaggtgggttatgtgccgaagttcgggcgcgctgcatccacgagtatactggtaacctcgagggtgggttag  
acaagtacgtctactcaagcggtgggtctatctgaagctccagcttacgacctgccaacgggcagtatggctactccgtgtggagctattgc  
ggtgttggtga

SEQ ID NO.: 16

Met Ala Lys Tyr Ser Glu Leu Glu Gly Gly Leu Ile Met Gln Ala Phe Tyr Trp Asp Val Pro Met  
Gly Gly Ile Trp Trp Asp Thr Ile Ala Gln Lys Ile Pro Asp Trp Ala Ser Ala Gly Ile Ser Ala Ile Trp  
Ile Pro Pro Ala Ser Lys Gly Met Gly Gly Ala Tyr Ser Met Gly Tyr Asp Pro Tyr Asp Phe Phe Asp

Figure 16E



Leu Gly Glu Tyr Asp Gln Lys Gly Thr Val Glu Thr Arg Phe Gly Ser Lys Gln Glu Leu Val Asn  
Met Ile Asn Thr Ala His Ala Tyr Gly Ile Lys Val Ile Ala Asp Ile Val Ile Asn His Arg Ala Gly Gly  
Asp Leu Glu Trp Asn Pro Phe Val Gly Asp Tyr Thr Trp Thr Asp Phe Ser Lys Val Ala Ser Gly Lys  
Tyr Thr Ala Asn Tyr Leu Asp Phe His Pro Asn Glu Leu His Ala Gly Asp Ser Gly Thr Phe Gly Gly  
Tyr Pro Asp Ile Cys His Asp Lys Ser Trp Asp Gln Tyr Trp Leu Trp Ala Ser Gln Glu Ser Tyr Ala  
Ala Tyr Leu Arg Ser Ile Gly Ile Asp Ala Trp Arg Phe Asp Tyr Val Lys Gly Tyr Gly Ala Trp Val  
Val Lys Asp Trp Leu Asp Trp Trp Gly Gly Trp Ala Val Gly Glu Tyr Trp Asp Thr Asn Val Asp Ala  
Leu Leu Asn Trp Ala Tyr Ser Ser Asp Ala Lys Val Phe Asp Phe Pro Leu Tyr Tyr Lys Met Asp Glu  
Ala Phe Asp Asn Lys Asn Ile Pro Ala Leu Val Ser Ala Leu Gln Asn Gly Gln Thr Val Val Ser Arg  
Asp Pro Phe Lys Ala Val Thr Phe Val Ala Asn His Asp Thr Asp Ile Ile Trp Asn Lys Tyr Pro Ala  
Tyr Ala Phe Ile Leu Thr Tyr Glu Gly Gln Pro Thr Ile Phe Tyr Arg Asp Tyr Glu Glu Trp Leu Asn  
Lys Asp Arg Leu Lys Asn Leu Ile Trp Ile His Asp His Leu Ala Gly Gly Ser Thr Asp Ile Val Tyr  
Tyr Asp Asn Asp Glu Leu Ile Phe Val Arg Asn Gly Tyr Gly Ser Lys Pro Gly Leu Ile Thr Tyr Ile  
Asn Leu Ala Ser Ser Lys Ala Gly Arg Trp Val Tyr Val Pro Lys Phe Ala Gly Ala Cys Ile His Glu  
Tyr Thr Gly Asn Leu Gly Gly Trp Val Asp Lys Tyr Val Tyr Ser Ser Gly Trp Val Tyr Leu Glu Ala  
Pro Ala Tyr Asp Pro Ala Asn Gly Gln Tyr Gly Tyr Ser Val Trp Ser Tyr Cys Gly Val Gly

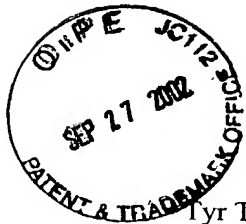
SEQ ID NO.: 17

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gggccagccgacaatattctaccgcgactacgaggagtggctcaacaaggataagctcaagaacctcatctggatcatgacaacctgccg  
gaggaagcacgagcatagtttactacgacagcgacgagatgatcttctgtaggaacggctatggaagcaagcctggccttataacttacatcaa  
cctcggtcgcagcaaggttggaaggtgggtttacgttcgaagttcgcaggctcgtgcatacacgagtacaccggcaatctcggcggttggtg  
ggacaagtgggtggactcaagcggctgggtctacctcgaggctcctgccacgacccggccaacggccagtacggctactccgtctggagc  
tactgcggtgttgggtga

SEQ ID NO.: 18

Met Ala Lys Tyr Ser Glu Leu Glu Gly Gly Gly Leu Ile Met Gln Ala Phe Tyr Trp Asp Val Pro Met  
Gly Gly Ile Trp Trp Asp Thr Ile Ala Gln Lys Ile Pro Asp Trp Ala Ser Ala Gly Ile Ser Ala Ile Trp  
Ile Pro Pro Ala Ser Lys Gly Met Gly Gly Ala Tyr Ser Met Gly Tyr Asp Pro Tyr Asp Phe Phe Asp  
Leu Gly Glu Tyr Asp Gln Glu Gly Thr Val Glu Thr Arg Phe Gly Ser Lys Gln Glu Leu Val Asn  
Met Ile Asn Thr Ala His Ala Tyr Gly Ile Lys Val Ile Ala Asp Ile Val Ile Asn His Arg Ala Gly Gly  
Asp Leu Glu Trp Asn Pro Phe Val Gly Asp Tyr Thr Trp Thr Asp Phe Ser Lys Val Ala Ser Gly Lys  
Tyr Thr Ala Asn Tyr Leu Asp Phe His Pro Asn Glu Val Lys Cys Cys Asp Glu Gly Thr Phe Gly  
Gly Phe Pro Asp Ile Ala His Glu Lys Ser Trp Asp Gln His Trp Leu Trp Ala Ser Asp Glu Ser Tyr  
Ala Ala Tyr Leu Arg Ser Ile Gly Val Asp Ala Trp Arg Phe Asp Tyr Val Lys Gly Tyr Gly Ala Trp  
Val Val Lys Asp Trp Leu Asp Trp Trp Gly Gly Trp Ala Val Gly Glu Tyr Trp Asp Thr Asn Val Asp  
Ala Leu Leu Asn Trp Ala Tyr Ser Ser Asp Ala Lys Val Phe Asp Phe Pro Leu Tyr Tyr Lys Met Asp  
Ala Ala Phe Asp Asn Lys Asn Ile Pro Ala Leu Val Glu Ala Leu Lys Asn Gly Gly Thr Val Val Ser  
Arg Asp Pro Phe Lys Ala Val Thr Phe Val Ala Asn His Asp Thr Asp Ile Ile Trp Asn Lys Tyr Pro  
Ala Tyr Ala Phe Ile Leu Thr Tyr Glu Gly Gln Pro Thr Ile Phe Tyr Arg Asp Tyr Glu Glu Trp Leu  
Asn Lys Asp Lys Leu Lys Asn Leu Ile Trp Ile His Asp Asn Leu Ala Gly Gly Ser Thr Ser Ile Val

Figure 16F



Tyr Tyr Asp Ser Asp Glu Met Ile Phe Val Arg Asn Gly Tyr Gly Ser Lys Pro Gly Leu Ile Thr Tyr  
Ile Asn Leu Gly Ser Ser Lys Val Gly Arg Trp Val Tyr Val Pro Lys Phe Ala Gly Ser Cys Ile His  
Glu Tyr Thr Gly Asn Leu Gly Gly Trp Val Asp Lys Trp Val Asp Ser Ser Gly Trp Val Tyr Leu Glu  
Ala Pro Ala His Asp Pro Ala Asn Gly Gln Tyr Gly Tyr Ser Val Trp Ser Tyr Cys Gly Val Gly

SEQ ID NO.: 19

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gctacgacccctacgattatgttgaccttggtgagtactaccagaagggaacgggtgaaacgaggttcggctcaaagcaggagctcataaacat  
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ctcaagcaaacgggaagggtgggttatgtgccgaagttcgcgggcgctgcatccacgagcactactggaacctcgaggctgggtagaca  
agtacgtctactcaagcggctgggtctatctcgaagctccagcttacgacctgccaacgggcagtatggctactccgtgtggagctactgcgg  
tgttgctga

SEQ ID NO.: 20

Met Ala Lys Tyr Leu Glu Leu Glu Gly Gly Leu Ile Met Gln Ala Phe Tyr Trp Asp Val Pro Met  
Gly Gly Ile Trp Trp Asp Thr Ile Ala Gln Lys Ile Pro Asp Trp Ala Ser Ala Gly Ile Ser Ala Ile Trp  
Ile Pro Pro Ala Ser Lys Gly Met Ser Gly Gly Tyr Ser Met Gly Tyr Asp Pro Tyr Asp Tyr Phe Asp  
Leu Gly Glu Tyr Tyr Gln Lys Gly Thr Val Glu Thr Arg Phe Gly Ser Lys Gln Glu Leu Ile Asn Met  
Ile Asn Thr Ala His Ala Tyr Gly Ile Lys Val Ile Ala Asp Ile Val Ile Asn His Arg Ala Gly Gly Asp  
Leu Glu Trp Asn Pro Phe Val Gly Asp Tyr Thr Trp Thr Asp Phe Ser Lys Val Ala Ser Gly Lys Tyr  
Thr Ala Asn Tyr Leu Asp Phe His Pro Asn Glu Leu His Ala Gly Asp Ser Gly Thr Phe Gly Gly Tyr  
Pro Asp Ile Cys His Asp Lys Ser Trp Asp Gln Tyr Trp Leu Trp Ala Ser Gln Glu Ser Tyr Ala Ala  
Tyr Leu Arg Ser Ile Gly Ile Asp Ala Trp Arg Phe Asp Tyr Val Lys Gly Tyr Ala Pro Trp Val Val  
Lys Asp Trp Leu Asn Trp Trp Gly Gly Trp Ala Val Gly Glu Tyr Trp Asp Thr Asn Val Asp Ala Val  
Leu Asn Trp Ala Tyr Ser Ser Gly Ala Lys Val Phe Asp Phe Ala Leu Tyr Tyr Lys Met Asp Glu Ala  
Phe Asp Asn Lys Asn Ile Pro Ala Leu Val Ser Ala Leu Gln Asn Gly Gln Thr Val Val Ser Arg Asp  
Pro Phe Lys Ala Val Thr Phe Val Ala Asn His Asp Thr Asp Ile Ile Trp Asn Lys Tyr Pro Ala Tyr  
Ala Phe Ile Leu Thr Tyr Glu Gly Gln Pro Thr Ile Phe Tyr Arg Asp Tyr Glu Glu Trp Leu Asn Lys  
Asp Arg Leu Lys Asn Leu Ile Trp Ile His Asp His Leu Ala Gly Gly Ser Thr Asp Ile Val Tyr Tyr  
Asp Asn Asp Glu Leu Ile Phe Val Arg Asn Gly Tyr Gly Ser Lys Pro Gly Leu Ile Thr Tyr Ile Asn  
Leu Ala Ser Ser Lys Ala Gly Arg Trp Val Tyr Val Pro Lys Phe Ala Gly Ala Cys Ile His Glu His  
Thr Gly Asn Leu Gly Gly Trp Val Asp Lys Tyr Val Tyr Ser Ser Gly Trp Val Tyr Leu Glu Ala Pro  
Ala Tyr Asp Pro Ala Asn Gly Gln Tyr Gly Tyr Ser Val Trp Ser Tyr Cys Gly Val Gly

SEQ ID NO.: 21

atggccaagtactccgagctggaagagggcggcgttataatgcaggccttctactgggacgtcccgaggtggaggaatctggtgggacaccat  
caggagcaagataccggagtgtacgagcggggaatatccgccatttgattcctccgggagcaagggtatgagcggcggtattcgatgg  
gctacgacccctacgatgatttgacctgggtgagtactaccagaagggaacgggtgaaacgaggttcggctcaaagcaggagctcataaac  
atgataaacacggcccatgcctacggcataaagggtcatagcggacatcgtcataaaccaccgcgcaggcggagacctcgagtgaacccgtt  
cgttggggactacacctggacggacttctcaaagggtggcctcgggcaatatactgccaactacctcgacttccaccgaacgagctccatgc  
ggcgattccgggaacatttgagggtatcccacatatgccacgacaagagctgggaccagtactggctctgggccagccaggagagctac



gcgggtatatctcaggagcatcggcatcgatgcctggcgcttcgactacgtcaagggtctacggagcgtgggtcgtcaaggactggctggactg  
gtggggagggctggccgtcggggagtactgggacacaaacgttgatgcactgtcgaactgggcctactcgagcgatgcaaaagtcttcgactt  
cccgtctactacaagatggatgaggcctttgacaacaaaacattccagcgctcgtctctgcccttcagaacggccagactgtgtctcccgcg  
accgttcaaggccgtaaccttttagcaaacacgacaccgatataatttgaacaagtaccggcctacgccttcacctacacactagaggg  
ccagccgacgatattctaccgcgactacgaggagtggctcaacaaggacaggtcgaagaacctcatctggatacacgactacctcgcgggtg  
gaagcactgacatcgtttactacgacaacgacgagctgatattcgtgagaacggctacggaagcaagccgggactgataacatacaaac  
tcgctcaagcaagccggaagggtgggttatgtgccgaagtgcggggcgctgcatccacgagtatactggtaacctcggaggtgtag  
acaagtacgtctactcaagcggctgggtctatctgaagctccagcttacgacctgccaacgggcagtatggctactccgtgtggagctta  
gggtgttgctga

SEQ ID NO.: 22

Met Ala Lys Tyr Ser Glu Leu Glu Gly Gly Val Ile Met Gln Ala Phe Tyr Trp Asp Val Pro Gly  
Gly Gly Ile Trp Trp Asp Thr Ile Arg Ser Lys Ile Pro Glu Trp Tyr Glu Ala Gly Ile Ser Ala Ile Trp  
Ile Pro Pro Gly Ser Lys Gly Met Ser Gly Gly Tyr Ser Met Gly Tyr Asp Pro Tyr Asp Asp Leu Asp  
Leu Gly Glu Tyr Tyr Gln Lys Gly Thr Val Glu Thr Arg Phe Gly Ser Lys Gln Glu Leu Ile Asn Met  
Ile Asn Thr Ala His Ala Tyr Gly Ile Lys Val Ile Ala Asp Ile Val Ile Asn His Arg Ala Gly Gly Asp  
Leu Glu Trp Asn Pro Phe Val Gly Asp Tyr Thr Trp Thr Asp Phe Ser Lys Val Ala Ser Gly Lys Tyr  
Thr Ala Asn Tyr Leu Asp Phe His Pro Asn Glu Leu His Ala Gly Asp Ser Gly Thr Phe Gly Gly Tyr  
Pro Asp Ile Cys His Asp Lys Ser Trp Asp Gln Tyr Trp Leu Trp Ala Ser Gln Glu Ser Tyr Ala Val  
Tyr Leu Arg Ser Ile Gly Ile Asp Ala Trp Arg Phe Asp Tyr Val Lys Gly Tyr Gly Ala Trp Val Val  
Lys Asp Trp Leu Asp Trp Trp Gly Gly Trp Ala Val Gly Glu Tyr Trp Asp Thr Asn Val Asp Ala  
Leu Leu Asn Trp Ala Tyr Ser Ser Asp Ala Lys Val Phe Asp Phe Pro Leu Tyr Tyr Lys Met Asp Glu  
Ala Phe Asp Asn Lys Asn Ile Pro Ala Leu Val Ser Ala Leu Gln Asn Gly Gln Thr Val Val Ser Arg  
Asp Pro Phe Lys Ala Val Thr Phe Val Ala Asn His Asp Thr Asp Ile Ile Trp Asn Lys Tyr Pro Ala  
Tyr Ala Phe Ile Leu Thr Tyr Glu Gly Gln Pro Thr Ile Phe Tyr Arg Asp Tyr Glu Glu Trp Leu Asn  
Lys Asp Arg Leu Lys Asn Leu Ile Trp Ile His Asp Tyr Leu Ala Gly Gly Ser Thr Asp Ile Val Tyr  
Tyr Asp Asn Asp Glu Leu Ile Phe Val Arg Asn Gly Tyr Gly Ser Lys Pro Gly Leu Ile Thr Tyr Ile  
Asn Leu Ala Ser Ser Lys Ala Gly Arg Trp Val Tyr Val Pro Lys Phe Ala Gly Ala Cys Ile His Glu  
Tyr Thr Gly Asn Leu Gly Gly Trp Val Asp Lys Tyr Val Tyr Ser Ser Gly Trp Val Tyr Leu Glu Ala  
Pro Ala Tyr Asp Pro Ala Asn Gly Gln Tyr Gly Tyr Ser Val Trp Ser Tyr Cys Gly Val Gly

SEQ ID NO.: 23

atggccaagtactccgagctggaagagggcggttatagtgcaggccttctactgggacgtccaggtggaggaatctgggtggacaccat  
caggagcaagataccggagtggtacgaggcgggaatatccgccatttggattccccggcgagcaagggtcgtggcgccgctattcgtatg  
ggctacgacccctacgacttcttgacctcgggtgagtacgaccagaagggaacggtagagacgcgtttggctccaagcaggagctcgtgaa  
catgataaacacggcccatgcctacggcataaaggtcatagcggacatcgtcataaaccaccgcgcaggcggagacctcgagtgaacccg  
ttcgttggggactacacctggacggacttctcaaggtggcctcgggcaatatactgccaactacctcgaacttcacccgaacgagctccatg  
cgggcgattcgggaacatttggaggctatcccgacatagccacgacaagagctgggaccagtactggctctgggccagccaggagagctac  
gcggcatatctcaggagcatcggcatcgatgcctggcgcttcgactacgtcaagggtctacggagcgtgggtcgtcaaggactggctggactg  
gtggggagggctggccgtcggggagtactgggacacaaacgttgatgcactgtcgaactgggcctactcgagcgatgcaaaagtcttcgactt  
cccgtctactacaagatggatgaggcctttgacaacaaaacattccagcgctcgtctctgcccttcagaacggccagactgtgtctcccgcg  
accgttcaaggccgtaaccttttagcaaacacgacaccgatataatctggaacaagtaccagcctacgcgttcacctcactacgaggg  
ccagccgacaatattctaccgcgactacgaggagtggctcaacaaggataagctcaagaacctcatctggatacatgacaacctcgcggag  
gaagcatgagcatagtttactacgacagcgacgagatgatcttcgtgaggaaacggctatggaagcaagcctggccttataacttacatcaacct  
ggctcgagcaaggttgaagggtgggtctacgttccgaagttcgcgggagcgtgcatccacgagtacaccggcaacctcggcggtgggtgg  
acaagtgggtggactcaagcgggtgggtgtacctcagggccctgcccacgacccggccaacggctattacgggtactccgtctggagctatt  
cggtgttgctga

SEQ ID NO.: 24

Figure 16H



Met Ala Lys Tyr Ser Glu Leu Glu Gly Gly Val Ile Val Gln Ala Phe Tyr Trp Asp Val Pro Gly  
Gly Gly Ile Trp Trp Asp Thr Ile Arg Ser Lys Ile Pro Glu Trp Tyr Glu Ala Gly Ile Ser Ala Ile Trp  
Ile Pro Pro Ala Ser Lys Gly Met Gly Gly Ala Tyr Ser Met Gly Tyr Asp Pro Tyr Asp Phe Phe Asp  
Leu Gly Glu Tyr Asp Gln Lys Gly Thr Val Glu Thr Arg Phe Gly Ser Lys Gln Glu Leu Val Asn  
Met Ile Asn Thr Ala His Ala Tyr Gly Ile Lys Val Ile Ala Asp Ile Val Ile Asn His Arg Ala Gly Gly  
Asp Leu Glu Trp Asn Pro Phe Val Gly Asp Tyr Thr Trp Thr Asp Phe Ser Lys Val Ala Ser Gly Lys  
Tyr Thr Ala Asn Tyr Leu Asp Phe His Pro Asn Glu Leu His Ala Gly Asp Ser Gly Thr Phe Gly Gly  
Tyr Pro Asp Ile Cys His Asp Lys Ser Trp Asp Gln Tyr Trp Leu Trp Ala Ser Gln Glu Ser Tyr Ala  
Ala Tyr Leu Arg Ser Ile Gly Ile Asp Ala Trp Arg Phe Asp Tyr Val Lys Gly Tyr Gly Ala Trp Val  
Val Lys Asp Trp Leu Asp Trp Trp Gly Gly Trp Ala Val Gly Glu Tyr Trp Asp Thr Asn Val Asp Ala  
Leu Leu Asn Trp Ala Tyr Ser Ser Asp Ala Lys Val Phe Asp Phe Pro Leu Tyr Tyr Lys Met Asp Glu  
Ala Phe Asp Asn Lys Asn Ile Pro Ala Leu Val Ser Ala Leu Gln Asn Gly Gln Thr Val Val Ser Arg  
Asp Pro Phe Lys Ala Val Thr Phe Val Ala Asn His Asp Thr Asp Ile Ile Trp Asn Lys Tyr Pro Ala  
Tyr Ala Phe Ile Leu Thr Tyr Glu Gly Gln Pro Thr Ile Phe Tyr Arg Asp Tyr Glu Glu Trp Leu Asn  
Lys Asp Lys Leu Lys Asn Leu Ile Trp Ile His Asp Asn Leu Ala Gly Gly Ser Met Ser Ile Val Tyr  
Tyr Asp Ser Asp Glu Met Ile Phe Val Arg Asn Gly Tyr Gly Ser Lys Pro Gly Leu Ile Thr Tyr Ile  
Asn Leu Gly Ser Ser Lys Val Gly Arg Trp Val Tyr Val Pro Lys Phe Ala Gly Ala Cys Ile His Glu  
Tyr Thr Gly Asn Leu Gly Gly Trp Val Asp Lys Trp Val Asp Ser Ser Gly Trp Val Tyr Leu Glu Ala  
Pro Ala His Asp Pro Ala Asn Gly Tyr Tyr Gly Tyr Ser Val Trp Ser Tyr Cys Gly Val Gly

SEQ ID NO.: 25

atggccaagtacgtcgagctcgaagagggcggggtcataatgcaggccttctactgggacgtcccatgggaggaatctggtgggacacgat  
agcccagaagatacccgactgggcaagcgccgggatttcggcgatatggattctcccgcgagcaagggtatgagcggcggtctatcgtatgg  
gctacgacccctacgattattttgacctcgggtgagtactaccagaagggaacgggtggaacagaggttcggctcaaagcaggagctcataaacat  
gataaacaccgcccacgcctatggcatgaaggaatagccgatatagtcatcaaccaccgcgccggcggtgacctggagtgaaccccttcgt  
gaacgactatacctggaccgacttctcaaaggctcgctcggtgtaatacacggccaactacctgacttccaccgaacgagctccatcgggg  
cgattccggaacatttgaggctatcccgcacatagccacgacaagagctgggaccagtgactggctctgggccaagcaggagactacgcgg  
catatctcaggagcattcggtcgtgctgctgactacgtcaagggtctgctccctgggtcgtcaaggactggctgaactggtgggg  
aggctgggctggttgagagtactgggacaccaacgtcgacgtgttctcaactgggcatactcgagcgggtgccaaggtctttgacttcgccctc  
tactacaagatggacgaggccttcgataacaacaacattcccgcctgggtgggcgccctcagatacgggtcagacagtggtcagccgcgaccc  
gttcaaggctgtgacgtttgtagccaaccacgataccgatataatctggaacaagtatccagcctacgcgttcacctacacgaggccagc  
cgacaatatctaccgcgactacgaggagtggctcaacaaggataagctcaagaacctcatctggatacatgacaacctgccggaggaagc  
accgacatagtctactacgataacgatgaactcatcttcgtcaggcacggctacggggacaagccggggcttataacctacatcaacctaggct  
cgagcaaggccggaagggtgggtttacgttcgaagttcgaggctcgtgcatacacgagtagaccggcaatctcggcggtgggtggacaa  
gtgggtggactcaagcggctgggtctacctcgaggctcctgccacgacccggccaacggccagtagcggctactccgctctggagctattgcg  
gtgttgggtga

SEQ ID NO.: 26

Met Ala Lys Tyr Leu Glu Leu Glu Gly Gly Leu Ile Met Gln Ala Phe Tyr Trp Asp Val Pro Met  
Gly Gly Ile Trp Trp Asp Thr Ile Ala Gln Lys Ile Pro Asp Trp Ala Ser Ala Gly Ile Ser Ala Ile Trp  
Ile Pro Pro Ala Ser Lys Gly Met Ser Gly Gly Tyr Ser Met Gly Tyr Asp Pro Tyr Asp Tyr Phe Asp  
Leu Gly Glu Tyr Tyr Gln Lys Gly Thr Val Glu Thr Arg Phe Gly Ser Lys Gln Glu Leu Ile Asn Met  
Ile Asn Thr Ala His Ala Tyr Gly Met Lys Val Ile Ala Asp Ile Val Ile Asn His Arg Ala Gly Gly Asp  
Leu Glu Trp Asn Pro Phe Val Asn Asp Tyr Thr Trp Thr Asp Phe Ser Lys Val Ala Ser Gly Lys Tyr  
Thr Ala Asn Tyr Leu Asp Phe His Pro Asn Glu Leu His Ala Gly Asp Ser Gly Thr Phe Gly Gly Tyr  
Pro Asp Ile Cys His Asp Lys Ser Trp Asp Gln Tyr Trp Leu Trp Ala Ser Gln Glu Ser Tyr Ala Ala  
Tyr Leu Arg Ser Ile Gly Ile Asp Ala Trp Arg Phe Asp Tyr Val Lys Gly Tyr Ala Pro Trp Val Val  
Lys Asp Trp Leu Asn Trp Trp Gly Gly Trp Ala Val Gly Glu Tyr Trp Asp Thr Asn Val Asp Ala Val  
Leu Asn Trp Ala Tyr Ser Ser Gly Ala Lys Val Phe Asp Phe Ala Leu Tyr Tyr Lys Met Asp Glu Ala  
Phe Asp Asn Asn Ile Pro Ala Leu Val Gly Ala Leu Arg Tyr Gly Gln Thr Val Val Ser Arg Asp

Figure 16I



Pro Phe Lys Ala Val Thr Phe Val Ala Asn His Asp Thr Asp Ile Ile Trp Asn Lys Tyr Pro Ala Tyr  
Ala Phe Ile Leu Thr Tyr Glu Gly Gln Pro Thr Ile Phe Tyr Arg Asp Tyr Glu Glu Trp Leu Asn Lys  
Asp Lys Leu Lys Asn Leu Ile Trp Ile His Asp Asn Leu Ala Gly Gly Ser Thr Asp Ile Val Tyr Tyr  
Asp Asn Asp Glu Leu Ile Phe Val Arg His Gly Tyr Gly Asp Lys Pro Gly Leu Ile Thr Tyr Ile Asn  
Leu Gly Ser Ser Lys Ala Gly Arg Trp Val Tyr Val Pro Lys Phe Ala Gly Ser Cys Ile His Glu Tyr  
Thr Gly Asn Leu Gly Gly Trp Val Asp Lys Trp Val Asp Ser Ser Gly Trp Val Tyr Leu Glu Ala Pro  
Ala His Asp Pro Ala Asn Gly Gln Tyr Gly Tyr Ser Val Trp Ser Tyr Cys Gly Val Gly

SEQ ID NO.: 27

atggcaagatattccgagctcgaagagggcggttataatgcaggccttctactgggacgtcccaggtggaggaatctggtgggacaccatc  
aggagcaagataccggagtgttacgagggcggaatatccgccatttggattcctcccgagcaagggtatgagcggcggtattcgaagg  
ctacgacccctacgattattttgacctgggtgagtactaccagaagggaacgggtgaaacagggttcggctcaaagcaggagctcataaacatg  
ataaacacggcccatgcctacggcataaaggatagcggacatcgtcataaaccaccgcgagggcgagacctcgagtgaacccgttcgt  
tggggactacacctggacggacttctcaaagggtggcctcgggcaaatatactccaactacctcgacttccaccgaacgagctccatgcggg  
cgattccggaacatttggaggctatcccacatatgccacgacaagagctgggaccagtactggctctgggccagccaggagagctacgagg  
catactcaggagcatcggcatcgatgcctggcgcttcgactacgtcaagggctatgctcctgggtcgtcaaggactggctgaactgggtggg  
aggctggggcggttgagagtactgggacaccaacgtcgacgctgttctcaactgggcatactcgagcgggtccaaggctttgacttcgcctc  
tactacaagatggacggcgctttgacaacaagaacattcccgcactcgtcgaggccctcaagaacgggggcacagtcgtcagccgcgacc  
cgtttaaggccgtaaccttgcgttcaaaccacgacaccgatataatctggaacaagtatccagcctacgcgttcacctcacctacgaggggcag  
ccgacaatatctaccgcgactacgaggagtggctcaacaaggataagctcaagaacctcatctggatacatgacaacctcgccggaggaag  
cactgacatcgtttactacgacaacgacgagctgatattcgtgagaacgggtacggaagcaagccgggactgataacatacatcaacctcgc  
gtcaagcaaaagccggaagggtgggtttacgttccgaagttcgaggctcgtgcatacacgagtacaccggcaatctcggcggtgggtggaca  
agtgggtggactcaagcgggtgggtctacctcagggtcctgccacgacccggccaacggccagtagcggctactcgtctggagctactgc  
ggtgttgggtga

SEQ ID NO.: 28

Met Ala Lys Tyr Ser Glu Leu Glu Glu Gly Gly Val Ile Met Gln Ala Phe Tyr Trp Asp Val Pro Gly  
Gly Gly Ile Trp Trp Asp Thr Ile Arg Ser Lys Ile Pro Glu Trp Tyr Glu Ala Gly Ile Ser Ala Ile Trp  
Ile Pro Pro Ala Ser Lys Gly Met Ser Gly Gly Tyr Ser Met Gly Tyr Asp Pro Tyr Asp Tyr Phe Asp  
Leu Gly Glu Tyr Tyr Gln Lys Gly Thr Val Glu Thr Arg Phe Gly Ser Lys Gln Glu Leu Ile Asn Met  
Ile Asn Thr Ala His Ala Tyr Gly Ile Lys Val Ile Ala Asp Ile Val Ile Asn His Arg Ala Gly Gly Asp  
Leu Glu Trp Asn Pro Phe Val Gly Asp Tyr Thr Trp Thr Asp Phe Ser Lys Val Ala Ser Gly Lys Tyr  
Thr Ala Asn Tyr Leu Asp Phe His Pro Asn Glu Leu His Ala Gly Asp Ser Gly Thr Phe Gly Gly Tyr  
Pro Asp Ile Cys His Asp Lys Ser Trp Asp Gln Tyr Trp Leu Trp Ala Ser Gln Glu Ser Tyr Ala Ala  
Tyr Leu Arg Ser Ile Gly Ile Asp Ala Trp Arg Phe Asp Tyr Val Lys Gly Tyr Ala Pro Trp Val Val  
Lys Asp Trp Leu Asn Trp Trp Gly Gly Trp Ala Val Gly Glu Tyr Trp Asp Thr Asn Val Asp Ala Val  
Leu Asn Trp Ala Tyr Ser Ser Gly Ala Lys Val Phe Asp Phe Ala Leu Tyr Tyr Lys Met Asp Ala Ala  
Phe Asp Asn Lys Asn Ile Pro Ala Leu Val Glu Ala Leu Lys Asn Gly Gly Thr Val Val Ser Arg Asp  
Pro Phe Lys Ala Val Thr Phe Val Ala Asn His Asp Thr Asp Ile Ile Trp Asn Lys Tyr Pro Ala Tyr  
Ala Phe Ile Leu Thr Tyr Glu Gly Gln Pro Thr Ile Phe Tyr Arg Asp Tyr Glu Glu Trp Leu Asn Lys  
Asp Lys Leu Lys Asn Leu Ile Trp Ile His Asp Asn Leu Ala Gly Gly Ser Thr Asp Ile Val Tyr Tyr  
Asp Asn Asp Glu Leu Ile Phe Val Arg Asn Gly Tyr Gly Ser Lys Pro Gly Leu Ile Thr Tyr Ile Asn  
Leu Ala Ser Ser Lys Ala Gly Arg Trp Val Tyr Val Pro Lys Phe Ala Gly Ser Cys Ile His Glu Tyr  
Thr Gly Asn Leu Gly Gly Trp Val Asp Lys Trp Val Asp Ser Ser Gly Trp Val Tyr Leu Glu Ala Pro  
Ala His Asp Pro Ala Asn Gly Gln Tyr Gly Tyr Ser Val Trp Ser Tyr Cys Gly Val Gly

SEQ ID NO.: 29

atggcaagatattccgagctcgaagagggcggttataatgcaggccttctactgggacgtcccaggtggaggaatctggtgggacaccggt  
agccagaagatacccgactgggcaagcgccgggtatttggcgatattggattccccggcgagcaaggcatggcgccgctattcgaagg  
ggctacgacccctacgacttcttgacctcgggtgagtacgaccagaagggaacggtagagacgcgcttggctccaagcaggagctcgtgaa

Figure 16J



SEQ ID NO.: 32

Met Ala Lys Tyr Ser Glu Leu Glu Gly Gly Val Ile Met Gln Ala Phe Tyr Trp Asp Val Pro Gly  
Gly Gly Ile Trp Trp Asp Thr Ile Arg Ser Arg Ile Pro Glu Trp Tyr Glu Ala Gly Ile Ser Ala Ile Trp  
Ile Pro Pro Ala Ser Lys Gly Met Gly Gly Ala Tyr Ser Met Gly Tyr Asp Pro Tyr Asp Phe Phe Asp  
Leu Gly Glu Tyr Asp Gln Lys Gly Thr Val Glu Thr Arg Phe Gly Ser Lys Gln Glu Leu Val Asn  
Met Ile Asn Thr Ala His Ala Tyr Gly Ile Lys Val Ile Ala Asp Ile Val Ile Asn His Arg Ala Gly C  
Asp Leu Glu Trp Asn Pro Phe Val Gly Asp Tyr Thr Trp Thr Asp Phe Ser Lys Val Ala Ser Gly Ly  
Tyr Thr Ala Asn Tyr Leu Asp Phe His Pro Asn Glu Leu His Ala Gly Asp Ser Gly Thr Phe Gly Gly  
Tyr Pro Asp Ile Cys His Asp Lys Ser Trp Asp Gln Tyr Trp Leu Trp Ala Ser Gln Glu Ser Tyr Ala  
Ala Tyr Leu Arg Ser Ile Gly Ile Asp Ala Trp Arg Phe Asp Tyr Val Lys Gly Tyr Gly Ala Trp Val  
Val Lys Asp Trp Leu Asn Trp Trp Gly Gly Trp Ala Val Gly Glu Tyr Trp Asp Thr Asn Val Asp Ala  
Leu Leu Asn Trp Ala Tyr Ser Ser Gly Ala Lys Val Phe Asp Phe Pro Leu Tyr Tyr Lys Met Asp Glu  
Ala Phe Asp Asn Asn Asn Ile Pro Ala Leu Val Asp Ala Leu Arg Tyr Gly Gln Thr Val Val Ser Arg  
Asp Pro Phe Lys Ala Val Thr Phe Val Ala Asn His Asp Thr Asp Ile Ile Trp Asn Lys Tyr Pro Ala  
Tyr Ala Phe Ile Leu Thr Tyr Glu Gly Gln Pro Thr Ile Phe Tyr Arg Asp Tyr Glu Glu Trp Leu Asn  
Lys Asp Lys Leu Lys Asn Leu Ile Trp Ile His Asp Asn Leu Ala Gly Gly Ser Thr Ser Ile Val Tyr  
Tyr Asp Ser Asp Glu Met Ile Phe Val Arg Thr Gly Tyr Gly Ser Lys Pro Gly Leu Ile Thr Tyr Ile  
Asn Leu Gly Ser Ser Lys Val Gly Arg Trp Val Tyr Val Pro Lys Phe Ala Gly Ala Cys Ile His Glu  
Tyr Thr Gly Asn Leu Gly Gly Trp Val Asp Lys Tyr Val Tyr Ser Ser Gly Trp Val Tyr Leu Glu Ala  
Pro Ala Tyr Asp Pro Ala Asn Gly Gln Tyr Gly Tyr Ser Val Trp Ser Tyr Cys Gly Val Gly

SEQ ID NO.: 33

atggccaagtactccgagctggaagagggcggggtcataatgcaggcgttctactgggacgtgccttcaggaggaatatggtgggacacaat  
acggcagaagataccggagtggtacgatgccggaatctccgcaatatggattctcccgcagcaagggtatgagcggcggtattcgcgatgg  
gctacgacctacgattatttgacctcggtgagtactaccagaagggaacgggtggaaacgaggttcggctcaaagcaggagctcataaacat  
gataaacacggcccatgctacggcataaaggtcatagcggacatcgtcataaaccaccgcgcaggcggagacctcgagtggaaacccgttc  
gttggggactacacctggacggactctcaaaggtggcctcgggcaaatatactgccaactacctgactccacccgaacgagctccatgcg  
ggcgattccgggaacatttgagggtatcccacatagccacgacaagagctgggaccagtactggctctgggccagccaggagactacgc  
ggcatactcaggagcatcggcatcgtgctggtgactacgtgaagggtactaggagctgggtcgtcaaggactggctcaactgggtg  
ggcggtgctgggcccgttgccgagtactgggacaccaacgttgatgcactcctcaactgggctactcagcggcgccaaggtcttcgactttcc  
gctctactacaagatggacgcggcctttgacaacaagaacattccgcactcgtcagggccctcaagaacgggggcacagtcgtcagccgcg  
accggttaaggccgtaacctcgttgcaaacacgacaccgatataatctggaccaagtaccttgcttatgctttcatcctacctacgaaggcca  
gcccgtcatattctaccgcgactacgaggagtggctcaacaaggacaggttgaaacacatcatgatacagaccacctcgcaggtggaag  
caccgacatagtctactacgataacgatgaactcatcttcgtaggaacgggtacggggacaagccggggcttataacctacatcaacctagc  
tcgagcaaggccggaaggtgggttacgttccgaagttcgcaggctcgtgcatacacgagtacaccggcaatctcggcggtgggtggacaa  
gtgggtggactcaagcggctgggtctacctcgaggctcctgccacgacccggccaacggccagtacggctactcgtctggagctactgcg  
gtgttggtga

SEQ ID NO.: 34

Met Ala Lys Tyr Ser Glu Leu Glu Gly Gly Val Ile Met Gln Ala Phe Tyr Trp Asp Val Pro Ser  
Gly Gly Ile Trp Trp Asp Thr Ile Arg Gln Lys Ile Pro Glu Trp Tyr Asp Ala Gly Ile Ser Ala Ile Trp  
Ile Pro Pro Ala Ser Lys Gly Met Ser Gly Gly Tyr Ser Met Gly Tyr Asp Pro Tyr Asp Tyr Phe Asp  
Leu Gly Glu Tyr Tyr Gln Lys Gly Thr Val Glu Thr Arg Phe Gly Ser Lys Gln Glu Leu Ile Asn Met  
Ile Asn Thr Ala His Ala Tyr Gly Ile Lys Val Ile Ala Asp Ile Val Ile Asn His Arg Ala Gly Gly Asp  
Leu Glu Trp Asn Pro Phe Val Gly Asp Tyr Thr Trp Thr Asp Phe Ser Lys Val Ala Ser Gly Lys Tyr  
Thr Ala Asn Tyr Leu Asp Phe His Pro Asn Glu Leu His Ala Gly Asp Ser Gly Thr Phe Gly Gly Tyr  
Pro Asp Ile Cys His Asp Lys Ser Trp Asp Gln Tyr Trp Leu Trp Ala Ser Gln Glu Ser Tyr Ala Ala  
Tyr Leu Arg Ser Ile Gly Ile Asp Ala Trp Arg Phe Asp Tyr Val Lys Gly Tyr Gly Ala Trp Val Val  
Lys Asp Trp Leu Asn Trp Trp Gly Gly Trp Ala Val Gly Glu Tyr Trp Asp Thr Asn Val Asp Ala

Figure 16K



catgataaacacggcccatgcctacggcataaaggctcatagcggacatcgtcataaaccaccgcgcaggcggagacctcgagtgaacccg  
ttcgttggggactacacctggacggacttctcaaagggtggtctcgggcaaataactgccaactacctcgacttccacccgaacgagctccatgc  
ggcggaattccggaacatttggaggctatcccacatatgccacgacaagagctgggaccagtactggctctggggccagccaggagagctac  
gcggcataatctcaggagcatcggcatcgatgcctggcgcttcgactacgtcaagggtatgctccctgggtcgtcaaggactggctgaactggt  
ggggagggtggggcgttgagagtagtgggacaccaacgtcgacgctgttctcaactgggcatactcgagcgggtccaaggctttgacttcg  
cccttactacaagatggatgaggcctttgacaacaaaaacattccagcgcctcgtctccttcagaacggccagactgtgtctcccgagac  
ccgttcaaggccgtaaccttttagcaaacacgacaccgatataatctggaacaagtacctgttatgccttcacctcacctacgaaggccag  
cccgtcatatttaccgcgactacgaggagtggctcaacaaggacagggtgaacaacctcatatggatacacgaccacctcgagggggaag  
caccgacatagtctactacgataacgatgaactcatcttcgtcaggaacggctacggggacaagccggggcttataacctacatcaacctaggc  
tcgagcaaggccggaagggtgggtttatgtccgaagttcggggcgctgcatccacgagtatactgtaacctcggaggctgggtagacaa  
gtactgtactcaagcggctgggtctatctcgaagctccagcttacgacctgccaacgggcagtatggctactccgtgtggagctactcggt  
gttgggtga

SEQ ID NO.: 30

Met Ala Lys Tyr Leu Glu Leu Glu Gly Gly Leu Ile Met Gln Ala Phe Tyr Trp Asp Val Pro Met  
Gly Gly Ile Trp Trp Asp Thr Val Ala Gln Lys Ile Pro Asp Trp Ala Ser Ala Gly Ile Ser Ala Ile Trp  
Ile Pro Pro Ala Ser Lys Gly Met Gly Gly Ala Tyr Ser Met Gly Tyr Asp Pro Tyr Asp Phe Phe Asp  
Leu Gly Glu Tyr Asp Gln Lys Gly Thr Val Glu Thr Arg Phe Gly Ser Lys Gln Glu Leu Val Asn  
Met Ile Asn Thr Ala His Ala Tyr Gly Ile Lys Val Ile Ala Asp Ile Val Ile Asn His Arg Ala Gly Gly  
Asp Leu Glu Trp Asn Pro Phe Val Gly Asp Tyr Thr Trp Thr Asp Phe Ser Lys Val Val Ser Gly Lys  
Tyr Thr Ala Asn Tyr Leu Asp Phe His Pro Asn Glu Leu His Ala Gly Asp Ser Gly Thr Phe Gly Gly  
Tyr Pro Asp Ile Cys His Asp Lys Ser Trp Asp Gln Tyr Trp Leu Trp Ala Ser Gln Glu Ser Tyr Ala  
Ala Tyr Leu Arg Ser Ile Gly Ile Asp Ala Trp Arg Phe Asp Tyr Val Lys Gly Tyr Ala Pro Trp Val  
Val Lys Asp Trp Leu Asn Trp Trp Gly Gly Trp Ala Val Gly Glu Tyr Trp Asp Thr Asn Val Asp Ala  
Val Leu Asn Trp Ala Tyr Ser Ser Gly Ala Lys Val Phe Asp Phe Ala Leu Tyr Tyr Lys Met Asp Glu  
Ala Phe Asp Asn Lys Asn Ile Pro Ala Leu Val Ser Ala Leu Gln Asn Gly Gln Thr Val Val Ser Arg  
Asp Pro Phe Lys Ala Val Thr Phe Val Ala Asn His Asp Thr Asp Ile Ile Trp Asn Lys Tyr Leu Ala  
Tyr Ala Phe Ile Leu Thr Tyr Glu Gly Gln Pro Val Ile Phe Tyr Arg Asp Tyr Glu Glu Trp Leu Asn  
Lys Asp Arg Leu Asn Asn Leu Ile Trp Ile His Asp His Leu Ala Gly Gly Ser Thr Asp Ile Val Tyr  
Tyr Asp Asn Asp Glu Leu Ile Phe Val Arg Asn Gly Tyr Gly Asp Lys Pro Gly Leu Ile Thr Tyr Ile  
Asn Leu Gly Ser Ser Lys Ala Gly Arg Trp Val Tyr Val Pro Lys Phe Ala Gly Ala Cys Ile His Glu  
Tyr Thr Gly Asn Leu Gly Gly Trp Val Asp Lys Tyr Val Tyr Ser Ser Gly Trp Val Tyr Leu Glu Ala  
Pro Ala Tyr Asp Pro Ala Asn Gly Gln Tyr Gly Tyr Ser Val Trp Ser Tyr Cys Gly Val Gly

SEQ ID NO.: 31

atggcaaaagtactccgagctggaagagggcggcgttataatgcaggccttctactgggacgtcccaggtggaggaatctggtgggacaccat  
caggagcaggataccggagtggtagaggcggaataatccgccatttggattccccggcgagcaaggggcatggggcgccctattcgatg  
ggctacgaccctacgacttctttgacctggtagtagcaccagaagggaacggtagagacgcgttggctccaagcaggagctcgtgaa  
catgataaacacggcccatgcctacggcataaaggctcatagcggacatcgtcataaaccaccgcgcaggcggagacctcgagtgaacccg  
ttcgttggggactacacctggacggacttctcaaagggtggcctcgggcaaataactgccaactacctcgacttccacccgaacgagctccatg  
cgggcgattccggaacatttggaggctatcccacatatgccacgacaagagctgggaccagtactggctctggggccagccaggagagctac  
gcggcataatctcaggagcatcggcatcgatgcctggcgctttgactacgtgaagggtacggagcgtgggtcgtcaaggactggctcaactgg  
tggggcggtggggcgttggcgagtactgggacaccaacgttgatgactcctcaactgggectactcgagcggcgccaagggtcttcgacttc  
ccgcttactacaagatggacgaggccttcgataacaacaacattcccgcctggtagcgcctcagatagcgtgagacagtggtcagccgc  
gacccgttcaaggctgtgacgttttagccaaccacgataccgatataatctggaacaagtatccagcctacgcgttcacctcacctacgaggg  
ccagccgacaattattaccgcgactacgaggagtggctcaacaaggataagctcaagaacctatctggatacatgacaacctggccggag  
gaagcacgagcatagttactacgacagcgacgagatgatctcgtgaggacggctatggaagcaagcctggccttataacttcatcaacct  
cggctcgagcaagggtggaagggtgggtttatgtccgaagttcggggcgctgcatccacgagtatactgtaacctcggaggctgggtaga  
caagtagcttactcaagcggctgggtctatctcgaagctccagcttacgacctgccaacgggcagtatggctactccgtgtggagctattgcg  
gtgtggctga

Figure 16L



Leu Leu Asn Trp Ala Tyr Ser Ser Gly Ala Lys Val Phe Asp Phe Pro Leu Tyr Tyr Lys Met Asp Ala  
Ala Phe Asp Asn Lys Asn Ile Pro Ala Leu Val Glu Ala Leu Lys Asn Gly Gly Thr Val Val Ser Arg  
Asp Pro Phe Lys Ala Val Thr Phe Val Ala Asn His Asp Thr Asp Ile Ile Trp Thr Lys Tyr Leu Ala  
Tyr Ala Phe Ile Leu Thr Tyr Glu Gly Gln Pro Val Ile Phe Tyr Arg Asp Tyr Glu Glu Trp Leu Asn  
Lys Asp Arg Leu Asn Asn Leu Ile Trp Ile His Asp His Leu Ala Gly Gly Ser Thr Asp Ile Val Tyr  
Tyr Asp Asn Asp Glu Leu Ile Phe Val Arg Asn Gly Tyr Gly Asp Lys Pro Gly Leu Ile Thr Tyr Ile  
Asn Leu Gly Ser Ser Lys Ala Gly Arg Trp Val Tyr Val Pro Lys Phe Ala Gly Ser Cys Ile His Glu  
Tyr Thr Gly Asn Leu Gly Gly Trp Val Asp Lys Trp Val Asp Ser Ser Gly Trp Val Tyr Leu Glu Ala  
Pro Ala His Asp Pro Ala Asn Gly Gln Tyr Gly Tyr Ser Val Trp Ser Tyr Cys Gly Val Gly

SEQ ID NO.: 35

atggccaagtactccgagctggaagagggcggttataatgcaggccttctactgggacgtcccagggtggaggaatctggtgggacaccat  
caggagcaagataccggagtggtacgagggggaatatccgccatttgattccccggcgagcaagggcatgggcggcctattcgatg  
ggctacgacccctacgacttcttgacctcggtgagtagcaccagaagggaacggtagagacgcgcttggctccaagcaggagctcgtgaa  
catgataaacaccgccacgcctacggcatcaaggtcatcgcagacatagtaataaccaccgcgcggaggagaccttgagtgaacccct  
tcgtcaatgactacacctggacggacttctgaaggctcgctccggcaagtacacggccaactacctgacttccaccccaacgaggtcaagtg  
ctgtgacgagggcacatttgagggttccagacatagcccacgagaagagctgggaccagcactggctctggcgagcgatgagagctac  
gccgcctacctaaggagcatcggttgatgcctggcgcttcgactacgtcaagggtatgctccctgggtcgtaaggactggctgaactggt  
ggggagggtggcggttgagagtactgggacaccaacgtcgacgctgttctcaactgggcatactcgagcggtgccaaggcttctgacttcg  
ccctctactacaagatggacgcggccttgacaacaagaacattccgcactcgtcaggccctcaagaacgggggcacagtcgtcagccgc  
gacccgttaaggccgtaacctcgttgcaaacacgacaccgatataatctggaacaagtatccagcctacgcgttcacctcacctacgaggg  
ccagccgacaatattctaccgcgactacgaggagtggctcaacaaggataagctcaagaacctcatctggatacatgacaacgtcgccggag  
gaagcaccgacatagtctactacgataacgatgaactcatctcgtcaggaacggctacggggacaagccggggttataacctacatcaacct  
aggctcgagcaaggccggaagggtgggttacgttccgaagttccgaggctcgtgcatacacgagtacaccggcaatctcggcggttggtg  
acaagtgggtgactcaagcggtgggtctacctcagggtcctgcccacgacccggccaacggccagtacggctactcgtctggagctac  
tgcggtgttggtga

SEQ ID NO.: 36

Met Ala Lys Tyr Ser Glu Leu Glu Glu Gly Gly Val Ile Met Gln Ala Phe Tyr Trp Asp Val Pro Gly  
Gly Gly Ile Trp Trp Asp Thr Ile Arg Ser Lys Ile Pro Glu Trp Tyr Glu Ala Gly Ile Ser Ala Ile Trp  
Ile Pro Pro Ala Ser Lys Gly Met Gly Gly Ala Tyr Ser Met Gly Tyr Asp Pro Tyr Asp Phe Phe Asp  
Leu Gly Glu Tyr Asp Gln Lys Gly Thr Val Glu Thr Arg Phe Gly Ser Lys Gln Glu Leu Val Asn  
Met Ile Asn Thr Ala His Ala Tyr Gly Ile Lys Val Ile Ala Asp Ile Val Ile Asn His Arg Ala Gly Gly  
Asp Leu Glu Trp Asn Pro Phe Val Asn Asp Tyr Thr Trp Thr Asp Phe Ser Lys Val Ala Ser Gly Lys  
Tyr Thr Ala Asn Tyr Leu Asp Phe His Pro Asn Glu Val Lys Cys Cys Asp Glu Gly Thr Phe Gly  
Gly Phe Pro Asp Ile Ala His Glu Lys Ser Trp Asp Gln His Trp Leu Trp Ala Ser Asp Glu Ser Tyr  
Ala Ala Tyr Leu Arg Ser Ile Gly Val Asp Ala Trp Arg Phe Asp Tyr Val Lys Gly Tyr Ala Pro Trp  
Val Val Lys Asp Trp Leu Asn Trp Trp Gly Gly Trp Ala Val Gly Glu Tyr Trp Asp Thr Asn Val Asp  
Ala Val Leu Asn Trp Ala Tyr Ser Ser Gly Ala Lys Val Phe Asp Phe Ala Leu Tyr Tyr Lys Met Asp  
Ala Ala Phe Asp Asn Lys Asn Ile Pro Ala Leu Val Glu Ala Leu Lys Asn Gly Gly Thr Val Val Ser  
Arg Asp Pro Phe Lys Ala Val Thr Phe Val Ala Asn His Asp Thr Asp Ile Ile Trp Asn Lys Tyr Pro  
Ala Tyr Ala Phe Ile Leu Thr Tyr Glu Gly Gln Pro Thr Ile Phe Tyr Arg Asp Tyr Glu Glu Trp Leu  
Asn Lys Asp Lys Leu Lys Asn Leu Ile Trp Ile His Asp Asn Val Ala Gly Gly Ser Thr Asp Ile Val  
Tyr Tyr Asp Asn Asp Glu Leu Ile Phe Val Arg Asn Gly Tyr Gly Asp Lys Pro Gly Leu Ile Thr Tyr  
Ile Asn Leu Gly Ser Ser Lys Ala Gly Arg Trp Val Tyr Val Pro Lys Phe Ala Gly Ser Cys Ile His  
Glu Tyr Thr Gly Asn Leu Gly Gly Trp Val Asp Lys Trp Val Asp Ser Ser Gly Trp Val Tyr Leu Glu  
Ala Pro Ala His Asp Pro Ala Asn Gly Gln Tyr Gly Tyr Ser Val Trp Ser Tyr Cys Gly Val Gly

SEQ ID NO.: 71

atggccaagtactccgagctggaagagggcggttataatgcaggccttctactgggacgtcccagggtggaggaatctggtgggacacaa

Figure 16M



Appin No.: 10/081,872

Applicant(s): Walter Callen et al.

ENZYMES HAVING ALPHA AMYLASE ACTIVITY AND  
METHODS OF USE THEREOF

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acggcagaagataccggagtggtagcatgccggaatctccgcaatatggattccccggcgagcaagggcatggggcggcctattcga  
ggctacgacccctacgacttcttgacctcggtgagtagcaccagaaggggaacggtagagacgcgctttggctccaagcaggagctcgtgaa  
catgataaacacggcccatgcctacggcataaaggtcatagcggacatcgtcataaaccaccgcgcaggcggagacctcgaagtgaacccg  
ttcgttggggactacacctggacggacttctcaaaaggtagcctcgggcaaatatactgccaactacctcgacttccaccgaacgagctccatg  
cgggcgattccgggaacatttggaggctatcccgacatagccacgacaagagctgggaccagtactggctctgggccagccaggagagctac  
gcggcatactcaggagcatcggcatcgatgcctggcgcttcgactacgtcaagggctatgctccctgggtcgtaaggactggctgaactggg  
ggggaggctggggcggtggagagtactgggacaccaacgtcgacgctgttctcaactgggcatactcgagcgggtccaaggtcttgacttcg  
cccttactacaagatggatgaggcctttgacaacaaaaacattccagcgcctcgtctctgcccttcagaacggccagactgttctccccgcac  
ccgttcaaggccgtaaccttttagcaaacacacacccgatataatctggaacaagtatccagcctacgcgttcacccacacacagggcc  
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agcactgacatcgattactacgacaacgacgagctgatattcgtgagaaacggctacggaagcaagccgggactgataacatacatcaacctc  
gcctcaagcaaaagccggaaggtgggtttatgtccgaagttcgcgggcgcggtcatccacgagtagtactggttaacctggaggctgggtaga  
caagtacgttactcaagcggctgggtctatctcgaagctccagcttacgacctgccaacggcgagtagtggtactccgtgtgagctactgc  
ggggtgggctga

SEQ ID NO.: 72

Met Ala Lys Tyr Leu Glu Leu Glu Gly Gly Val Ile Met Gln Ala Phe Tyr Trp Asp Val Pro Ser  
Gly Gly Ile Trp Trp Asp Thr Ile Arg Gln Lys Ile Pro Glu Trp Tyr Asp Ala Gly Ile Ser Ala Ile Trp  
Ile Pro Pro Ala Ser Lys Gly Met Gly Gly Ala Tyr Ser Met Gly Tyr Asp Pro Tyr Asp Phe Phe Asp  
Leu Gly Glu Tyr Asp Gln Lys Gly Thr Val Glu Thr Arg Phe Gly Ser Lys Gln Glu Leu Val Asn  
Met Ile Asn Thr Ala His Ala Tyr Gly Ile Lys Val Ile Ala Asp Ile Val Ile Asn His Arg Ala Gly Gly  
Asp Leu Glu Trp Asn Pro Phe Val Gly Asp Tyr Thr Trp Thr Asp Phe Ser Lys Val Ala Ser Gly Lys  
Tyr Thr Ala Asn Tyr Leu Asp Phe His Pro Asn Glu Leu His Ala Gly Asp Ser Gly Thr Phe Gly Gly  
Tyr Pro Asp Ile Cys His Asp Lys Ser Trp Asp Gln Tyr Trp Leu Trp Ala Ser Gln Glu Ser Tyr Ala  
Ala Tyr Leu Arg Ser Ile Gly Ile Asp Ala Trp Arg Phe Asp Tyr Val Lys Gly Tyr Ala Pro Trp Val  
Val Lys Asp Trp Leu Asn Trp Trp Gly Gly Trp Ala Val Gly Glu Tyr Trp Asp Thr Asn Val Asp Ala  
Val Leu Asn Trp Ala Tyr Ser Ser Gly Ala Lys Val Phe Asp Phe Ala Leu Tyr Tyr Lys Met Asp Glu  
Ala Phe Asp Asn Lys Asn Ile Pro Ala Leu Val Ser Ala Leu Gln Asn Gly Gln Thr Val Val Ser Arg  
Asp Pro Phe Lys Ala Val Thr Phe Val Ala Asn His Asp Thr Asp Ile Ile Trp Asn Lys Tyr Pro Ala  
Tyr Ala Phe Ile Leu Thr Tyr Glu Gly Gln Pro Thr Ile Phe Tyr Arg Asp Tyr Glu Glu Trp Leu Asn  
Lys Asp Lys Leu Lys Asn Leu Ile Trp Ile His Asp Asn Leu Ala Gly Gly Ser Thr Asp Ile Val Tyr  
Tyr Asp Asn Asp Glu Leu Ile Phe Val Arg Asn Gly Tyr Gly Ser Lys Pro Gly Leu Ile Thr Tyr Ile  
Asn Leu Ala Ser Ser Lys Ala Gly Arg Trp Val Tyr Val Pro Lys Phe Ala Gly Ala Cys Ile His Glu  
Tyr Thr Gly Asn Leu Gly Gly Trp Val Asp Lys Tyr Val Tyr Ser Ser Gly Trp Val Tyr Leu Glu Ala  
Pro Ala Tyr Asp Pro Ala Asn Gly Gln Tyr Gly Tyr Ser Val Trp Ser Tyr Cys Gly Val Gly

SEQ ID NO.: 49

gtggttatgacgatgtccgctatgacctttatgccgtaggcatggggcggtgttatcatgttcacgagctcctgcttgagccaaagcgcgtctct  
accgttcccttctggctgtactcaccgaggtcaaagaagtcgtaggggtcgtagcccatcgaataggcgcgccccatgcccttgctcgccggg  
ggaatccatcgcggaaatccggcgcttgcccagtcgggtatcttctgggctatcgtgtccaccagattctccatggggacgtccagta  
gaaggcctgcattatgagcccgccctcttcgagcccggaatactttgccataagttacctctactagtagattaaaattctgttctgtgaaatt  
gtt

SEQ ID NO.: 50

Val Val Tyr Asp Asp Val Arg Tyr Asp Leu Tyr Ala Val Gly Met Gly Arg Val Tyr His Val His Glu  
Leu Leu Leu Gly Ala Lys Ala Arg Leu Tyr Arg Ser Leu Leu Val Leu Thr Glu Val Lys Glu Val  
Val Gly Val Val Ala His Arg Ile Gly Ala Ala His Ala Leu Ala Arg Arg Gly Asn Pro Tyr Arg Arg  
Asn Pro Gly Ala Cys Pro Val Gly Tyr Leu Leu Gly Tyr Arg Val Pro Pro Asp Ser Ser His Gly Asp  
Val Pro Val Glu Gly Leu His Tyr Glu Pro Ala Leu Phe Glu Pro Gly Ile Leu Cys His Lys Leu Pro  
Pro Thr Ser Arg Leu Lys Phe Cys Phe Leu Cys Glu Ile Val

Figure 16N



SEQ ID NO.: 51

ATGGCCAAGTACCTGGAGCTCGAAGAGGGCGGGGTCATAATGCAGGCGTTCTACTGGG  
ACGTGCCTTCAGGAGGAATATGGTGGGACACAATACGGCAGAAGATACCGGAGTGGT  
ACGATGCCGGAATCTCCGCAATATGGATTCCCCCGGCGAGCAAGGGCATGGGCGGCGC  
CTATTCGATGGGCTACGACCCCTACGACTTCTTTGACCTCGGTGAGTACGACCAGAAG  
GGAACGGTAGAGACGCGCTTTGGCTCCAAGCAGGAGCTCGTGAACATGATAAACACC  
GCCCACGCCTATGGCATGAAGGTAATAGCCGATATAGTCATCAACCACCGCGCCGGCG  
GTGACCTGGAGTGGAAACCCCTTCGTGAACGACTATACCTGGACCGACTTCTCAAAGGT  
CGCGTCGGGTAAATACACGGCCAACCTACCTCGACTTCCACCCCAACGAGGTCAAGTGC  
TGTGACGAGGGCACATTTGGAGGCTTCCCAGACATAGCCCACGAGAAGAGCTGGGAC  
CAGCACTGGCTCTGGGCGAGCGATGAGAGCTACGCCGCCTACCTAAGGAGCATCGGCG  
TTGATGCCTGGCGCTTTGACTACGTGAAGGGCTACGGAGCGTGGGTCTGCAAGGACTG  
GCTCAACTGGTGGGCGGCTGGGCGGTGGCGTACTGGGACACCAACGTTGATGCA  
CTCCTCAACTGGGCGCTACTCGAGCGGCGCCAAGGTCTTCGACTTCCCGCTCTACTACAA  
GATGGATGAGGCCTTTGACAACAAAAACATTCCAGCGCTCGTCTCTGCCCTTCAGAA  
GGCCAGACTGTTGTCTCCCGCGACCCGTTCAAGGCCGTAACCTTTGTAGCAAACACG  
ACACCGATATAATCTGGAACAAGTATCCAGCCTACGCGTTTCCTCACCTACGAGGG  
CCAGCCGACAATATTCTACCGCGACTACGAGGAGTGGCTCAACAAGGATAAGCTCAAG  
AACCTCATCTGGATACATGACAACCTCGCCGGAGGAAGCACTGACATCGTTTACTACG  
ACAACGACGAGCTGATATTCGTGAGAAACGGCTACGGAAGCAAGCCGGGACTGATAA  
CATAATCAACCTCGCCTCAAGCAAAGCCGGAAGGTGGGTTTACGTTCCGAAGTTCGC  
AGGCTCGTGATACACGAGTACACCGGCAATCTCGGCGGCTGGGTGGACAAGTGGGTG  
GACTCAAGCGGCTGGGTCTACCTCGAGGCTCCTGCCACGACCCGGCCAACGGCCAGT  
ACGGCTACTCCGTCTGGAGCTATTGCGGTGTTGGCTGA

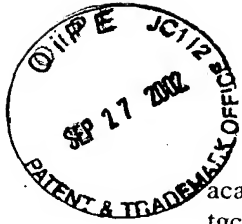
SEQ ID NO.: 52

MAKYLELEEGGVIMQAFYWDVPSGGIWWDITIRQKIPWYDAGISAIWIPPASKGMGGAYS  
MGYDPYDFDLGEYDQKGTVETFRGSKQELVNMINTAHAYGMKVIADIVINHRAGGDLE  
WNPVNDYTWTDVSKVASGKYTANYLDFHPNEVKCCDEGTFGGFPDIAHEKSWDQHWL  
WASDESYAAYLRSIGVDAWRFDYVKGYGAWVKDWLNWWGGWAVGEYWDTNVDAL  
LNWAYSSGAKVDFPLYKMDAEDFNKNIPALVLSALQNGQTVVSRDPFKAVTFVANHDT  
DIIWNKYPAYAFILTYEQPTIFYRDYEEWLNDKDKLKNLIWIHDNLAGGSTDIVYYDNDELI  
FVRNGYGSKPLITYINLASSKAGRWVYVPKFAGSCIHEYTGNLGGWVDKWVDSSGWVY  
LEAPAHDPANGQYGYSVWSYCGVG

SEQ ID NO.: 37

atggccaagtacctggagctcgaagagggcggggtcataatgcaggcgttctactgggacgtgccttcaggaggaatatggtgggacacaat  
acggcagaagataccggagtggtacgatgccggaatctccgcaatatggattccccggcgagcaagggcatgggcggcgctattcgatg  
ggctacgaccctacgacttcttgacctcgtgagtagaccagaagggaacggtagagacgcgctttggctccaagcaggagctcgtgaa  
catgataaacaccgcccacgcctatggcatgaaggtaatagccgatatagtcatcaaccaccgcgcggcggtgacctggagtgaacccctt  
cgtgaacgactatacctggaccgacttctcaaaggctcgcgtcgggtaatacacggccaactacctgacttccaccgaacgagctccatgc  
ggcgattccggaacatttgaggctatcccgacatatgccacgacaagagctgggaccagtactggctctgggccaagcaggagagctac  
gcggcatatctcaggagcatcggcatcgatgcctggcgcttgactacgtgaagggtacggagcgcgggtcgtaaggactggctcaactg  
gtggggcggtggcgcttgaggctgagtagctgggacccaacgttgatgactcctcaactgggctactcgagcggcgccaaggtcttcgact  
cccgtctactacaagatggatgaggccttgacaacaaaacattccagcgctcgtctctgcccttcagaacggccagactgtgtctccgcg  
accggttcaaggccgtaaccttttagcaaacacgacaccgatataatctggaacaagtatccagcctacgcgttcatctcactacgaggg  
ccagccgacaatatctatcgcgactacgaggagtggctcaacaaggataagctcaagaacctcatctggatacatgacaacctcggcgagg  
aagactgacatcgttactacgacaacgacgagctgatattcgtgagaacggctacggaagcaagccgggactgataacatacatcaacct  
cgctcaagcaaacgggaaggtgggtttacgttccgaagtcgcaggctcgtgcatacacgagtagaccggcaatctcggcggtgggtgg

Figure 160



acaagtgggtggactcaagcggctgggtctacctcgaggctcctgccacgacccggccaacggccagtacggctactccgtctggagctac  
tgcgggggtgggggtga

SEQ ID NO.: 38

Met Ala Lys Tyr Leu Glu Leu Glu Gly Gly Val Ile Met Gln Ala Phe Tyr Trp Asp Val Pro Ser  
Gly Gly Ile Trp Trp Asp Thr Ile Arg Gln Lys Ile Pro Glu Trp Tyr Asp Ala Gly Ile Ser Ala Ile Trp  
Ile Pro Pro Ala Ser Lys Gly Met Gly Gly Ala Tyr Ser Met Gly Tyr Asp Pro Tyr Asp Phe Phe Asp  
Leu Gly Glu Tyr Asp Gln Lys Gly Thr Val Glu Thr Arg Phe Gly Ser Lys Gln Glu Leu Val Asn  
Met Ile Asn Thr Ala His Ala Tyr Gly Met Lys Val Ile Ala Asp Ile Val Ile Asn His Arg Ala Gly Gly  
Asp Leu Glu Trp Asn Pro Phe Val Asn Asp Tyr Thr Trp Thr Asp Phe Ser Lys Val Ala Ser Gly Lys  
Tyr Thr Ala Asn Tyr Leu Asp Phe His Pro Asn Glu Leu His Ala Gly Asp Ser Gly Thr Phe Gly Gly  
Tyr Pro Asp Ile Cys His Asp Lys Ser Trp Asp Gln Tyr Trp Leu Trp Ala Ser Gln Glu Ser Tyr Ala  
Ala Tyr Leu Arg Ser Ile Gly Ile Asp Ala Trp Arg Phe Asp Tyr Val Lys Gly Tyr Gly Ala Arg Val  
Val Lys Asp Trp Leu Asn Trp Trp Gly Gly Trp Ala Val Gly Glu Tyr Trp Asp Thr Asn Val Asp Ala  
Leu Leu Asn Trp Ala Tyr Ser Ser Gly Ala Lys Val Phe Asp Phe Pro Leu Tyr Tyr Lys Met Asp Glu  
Ala Phe Asp Asn Lys Asn Ile Pro Ala Leu Val Ser Ala Leu Gln Asn Gly Gln Thr Val Val Ser Arg  
Asp Pro Phe Lys Ala Val Thr Phe Val Ala Asn His Asp Thr Asp Ile Ile Trp Asn Lys Tyr Pro Ala  
Tyr Ala Phe Ile Leu Thr Tyr Glu Gly Gln Pro Thr Ile Phe Tyr Arg Asp Tyr Glu Glu Trp Leu Asn  
Lys Asp Lys Leu Lys Asn Leu Ile Trp Ile His Asp Asn Leu Ala Gly Gly Ser Thr Asp Ile Val Tyr  
Tyr Asp Asn Asp Glu Leu Ile Phe Val Arg Asn Gly Tyr Gly Ser Lys Pro Gly Leu Ile Thr Tyr Ile  
Asn Leu Ala Ser Ser Lys Ala Gly Arg Trp Val Tyr Val Pro Lys Phe Ala Gly Ser Cys Ile His Glu  
Tyr Thr Gly Asn Leu Gly Gly Trp Val Asp Lys Trp Val Asp Ser Ser Gly Trp Val Tyr Leu Glu Ala  
Pro Ala His Asp Pro Ala Asn Gly Gln Tyr Gly Tyr Ser Val Trp Ser Tyr Cys Gly Val Gly

SEQ ID NO.: 39

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gtactagacccctacgattattttgacctcggtagtactaccagaaggggaacgggtgaaacgaggttcggctcaaagcaggagctcataaacat  
gataaacaccgcccacgcctatggcatgaaggtaatagccgatatagtcatcaaccaccgcgccggcggtgacctggagtggaaccccttcgt  
gaacgactatacctggaccgacttctcaaaagtcgcgtcgggtaaatacacggccaactacctcgaactccaccgaacgagctccatgcggg  
cgattccggaacatttggaggtatcccgacatatgccacgacaagagctgggaccagtactggctctgggccaagcaggagagctacgcgg  
catatctcaggagcatcggatcgccttgagcgttgcctgactacgtgaagggtacggagcgtgggtcgtcaaggactggctcaactggtggg  
gcggctgggcccgttggcgagtactgggaccccaacgttgatgccctcctccctgggctactcagcggcgccaaggtcttcgaactcccg  
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ttcaaggccgtaacctttgtagccaaccacgataccgataatctggaacaagatccagcctacgcgttcacctcacctacgaggccagcc  
gacaatattctaccgcgactacgaggagtggtcacaagaagataagctcaagaacctcatctggatacatgacaacctcgcggaggaagca  
ccgacatagcttactacgataacgatgaactcatcttcgaggaacgggtacggggacaagccggggcttataacctacatcaacctaggctc  
gagcaaggccgggaaggtgggtctacgttcgaagttcgcgggagcgtcatccacgagtacaccggcaacctcggcggtgggtggacaa  
gtgggtggactcaagcgggtgggtgtacctcgaaggccctgccacgacccggccaacggctattacggctactccgtctggagctactgcg  
gggtgggctga

SEQ ID NO.: 40

Met Ala Lys Tyr Leu Glu Leu Glu Gly Gly Val Ile Met Gln Ala Phe Tyr Trp Asp Val Pro Ser  
Gly Gly Ile Trp Trp Asp Thr Ile Arg Gln Lys Ile Pro Glu Trp Tyr Asp Ala Gly Ile Ser Ala Ile Trp  
Ile Pro Pro Ala Ser Arg Gly Met Ser Gly Gly Tyr Ser Met Gly Tyr Asp Pro Tyr Asp Tyr Phe Asp  
Leu Gly Glu Tyr Tyr Gln Lys Gly Thr Val Glu Thr Arg Phe Gly Ser Lys Gln Glu Leu Ile Asn Met  
Ile Asn Thr Ala His Ala Tyr Gly Met Lys Val Ile Ala Asp Ile Val Ile Asn His Arg Ala Gly Gly Asp  
Leu Glu Trp Asn Pro Phe Val Asn Asp Tyr Thr Trp Thr Asp Phe Ser Lys Val Ala Ser Gly Lys Tyr  
Thr Ala Asn Tyr Leu Asp Phe His Pro Asn Glu Leu His Ala Gly Asp Ser Gly Thr Phe Gly Gly Tyr  
Pro Asp Ile Cys His Asp Lys Ser Trp Asp Gln Tyr Trp Leu Trp Ala Ser Gln Glu Ser Tyr Ala Ala

Figure 16P

Tyr Leu Arg Ser Ile Gly Ile Asp Ala Trp Arg Phe Asp Tyr Val Lys Cly Tyr Gly Ala Trp Val Val  
 Lys Asp Trp Leu Asn Trp Trp Gly Gly Trp Ala Val Gly Glu Tyr Trp Asp Pro Asn Val Asp Ala Leu  
 Leu Pro Trp Ala Tyr Ser Ser Gly Ala Lys Val Phe Asp Phe Pro Leu Tyr Tyr Lys Met Asp Glu Ala  
 Phe Asp Asn Lys Asn Ile Pro Ala Leu Val Ser Ala Leu Gln Asn Gly Gln Thr Val Val Ser Arg Asp  
 Pro Phe Lys Ala Val Thr Phe Val Ala Asn His Asp Thr Asp Ile Ile Trp Asn Lys Tyr Pro Ala Tyr  
 Ala Phe Ile Leu Thr Tyr Glu Gly Gln Pro Thr Ile Phe Tyr Arg Asp Tyr Glu Glu Trp Leu Asn Lys  
 Asp Lys Leu Lys Asn Leu Ile Trp Ile His Asp Asn Leu Ala Gly Gly Ser Thr Asp Ile Val Tyr Tyr  
 Asp Asn Asp Glu Leu Ile Phe Val Arg Asn Gly Tyr Gly Asp Lys Pro Gly Leu Ile Thr Tyr Ile Asn  
 Leu Gly Ser Ser Lys Ala Gly Arg Trp Val Tyr Val Pro Lys Phe Ala Gly Ala Cys Ile His Glu Tyr  
 Thr Gly Asn Leu Gly Gly Trp Val Asp Lys Trp Val Asp Ser Ser Gly Trp Val Tyr Leu Glu Ala Pro  
 Ala His Asp Pro Ala Asn Gly Tyr Tyr Gly Tyr Ser Val Trp Ser Tyr Cys Gly Val Gly

SEQ ID NO.: 41

atggccaagtacctggagctcgaagagggcggggtcataatgcaggcgttctactgggacgtgccttcaggaggaatatgggggacacaat  
 acggcagaagataccggagtggtacgatccggaatctccgcaatatggattcctcccgagcaagggtatgagcggcggtattcgatgg  
 gctacgaccctacgattattttgacctcggtgagtactaccagaagggaacgggtgaaacgaggttcggctcaaaagcaggagctcataaacat  
 gataaacacggccatgcctacggcataaaggtcatagcggacatcgtcataaaccaccgcgcaggcggagacctcagtggaacccgttc  
 gttggggactacacctggacggacttctcaaaaggtggcctcgggcaaatatactgccaactacctcgacttccacccgaacgagctccatgcg  
 ggcatcctcaggagcatcggcatcgtgctggcgctttgactacgtgaagggctaccggagcgtgggtcgtcaaggactggctcaactgggtg  
 gggcggtcggggttggtggcagtagtgggacaccaacgttgatgactcctcaactgggcctactcgagcggcgccaaggtcttcgacttccc  
 gctctactacaagatggacgcggcctttgacaacaagaacattcccgactcgtcgaggccctcaagaacgggggcacagtcgtcagccgcg  
 acccggttaaggccgtaaccttcgttgcaaacacgacaccgatataatctggaacaagtatccagcctacgcgttcacctcacctacgagggc  
 cagccgacaatatctaccgcgactacgaggagtggtcgaacaaggataagctcaagaacctcatctggatacatgacaacctcgccggagg  
 aagcacgagcatagttactacgacagcgacgagatgatcttcgtgaggaacggctatggaagcaagcctggccttataacttacatcaacctc  
 ggctcgagcaaggttggaaggtgggttatgtgccgaagttcgcgggcgctgcatccacgagtatactggaacctcgagggtgggttagac  
 aagtacgtctactcaagcggtgggtctatctcgaagctccagcttacgacctgccaacgggcagtagtggtactccgtgtggagctactcg  
 gtgtgggtga

SEQ ID NO.: 42

Met Ala Lys Tyr Leu Glu Leu Glu Gly Gly Val Ile Met Gln Ala Phe Tyr Trp Asp Val Pro Ser  
 Gly Gly Ile Trp Trp Asp Thr Ile Arg Gln Lys Ile Pro Glu Trp Tyr Asp Ala Gly Ile Ser Ala Ile Trp  
 Ile Pro Pro Ala Ser Lys Gly Met Ser Gly Gly Tyr Ser Met Gly Tyr Asp Pro Tyr Asp Tyr Phe Asp  
 Leu Gly Glu Tyr Tyr Gln Lys Gly Thr Val Glu Thr Arg Phe Gly Ser Lys Gln Glu Leu Ile Asn Met  
 Ile Asn Thr Ala His Ala Tyr Gly Ile Lys Val Ile Ala Asp Ile Val Ile Asn His Arg Ala Gly Gly Asp  
 Leu Glu Trp Asn Pro Phe Val Gly Asp Tyr Thr Trp Thr Asp Phe Ser Lys Val Ala Ser Gly Lys Tyr  
 Thr Ala Asn Tyr Leu Asp Phe His Pro Asn Glu Leu His Ala Gly Asp Ser Gly Thr Phe Gly Gly Tyr  
 Pro Asp Ile Cys His Asp Lys Ser Trp Asp Gln Tyr Trp Leu Trp Ala Ser Gln Glu Ser Tyr Ala Ala  
 Tyr Leu Arg Ser Ile Gly Ile Asp Ala Trp Arg Phe Asp Tyr Val Lys Gly Tyr Gly Ala Trp Val Val  
 Lys Asp Trp Leu Asn Trp Trp Gly Gly Trp Ala Val Gly Glu Tyr Trp Asp Thr Asn Val Asp Ala  
 Leu Leu Asn Trp Ala Tyr Ser Ser Gly Ala Lys Val Phe Asp Phe Pro Leu Tyr Tyr Lys Met Asp Ala  
 Ala Phe Asp Asn Lys Asn Ile Pro Ala Leu Val Glu Ala Leu Lys Asn Gly Gly Thr Val Val Ser Arg  
 Asp Pro Phe Lys Ala Val Thr Phe Val Ala Asn His Asp Thr Asp Ile Ile Trp Asn Lys Tyr Pro Ala  
 Tyr Ala Phe Ile Leu Thr Tyr Glu Gly Gln Pro Thr Ile Phe Tyr Arg Asp Tyr Glu Glu Trp Leu Asn  
 Lys Asp Lys Leu Lys Asn Leu Ile Trp Ile His Asp Asn Leu Ala Gly Gly Ser Thr Ser Ile Val Tyr  
 Tyr Asp Ser Asp Glu Met Ile Phe Val Arg Asn Gly Tyr Gly Ser Lys Pro Gly Leu Ile Thr Tyr Ile  
 Asn Leu Gly Ser Ser Lys Val Gly Arg Trp Val Tyr Val Pro Lys Phe Ala Gly Ala Cys Ile His Glu  
 Tyr Thr Gly Asn Leu Gly Gly Trp Val Asp Lys Tyr Val Tyr Ser Ser Gly Trp Val Tyr Leu Glu Ala  
 Pro Ala Tyr Asp Pro Ala Asn Gly Gln Tyr Gly Tyr Ser Val Trp Ser Tyr Cys Gly Val Gly

Figure 16Q



SEQ ID NO.: 43

atggccaagtactccgagctggaagagggcggcggtataatgcaggccttctactgggacgtcccaggtggaggaatctggtgggacaccat  
caggagcaagataccggagtggtacgagggcgggaatatccgccatttggattccccggcgagcaagggcatggcgggcgccctattcgatg  
ggctacgacccctacgacttcttgacctcggtagtacgaccagaagggaacggtagagacgcgtttggctccaagcaggagctcgtgaa  
catgataaacacggcccatgcctacggcataaaggtcatagcggacatcgtcataaaccaccgcgcaggcggagacctcgagtgaacccg  
ttcgttggggactacacctggacggacttctcaaaggtggcctcgggcaaatatactccaactacctcgacttccacccaacgagggtcaagt  
gctgtgacgagggcacatttggaggcttcccagacatagcccacgagaagagctgggaccagcactggctctgggcgagcgatgagagcta  
cgccgcctactaaggagcatcggtgatgcctggcgcttcgactacgtcaagggtacggagcgtgggtcgtcaaggactggctggact  
ggtggggaggtggcgctcggggagtactgggacacaaacgttgatgcactgctcaactgggcctactcgagcgatgcaaaagtcttcgac  
tccccgtctactacaagatggatgaggcctttgacaacaaaacattccagcgcctcgtctcgtccctcagaacggccagactgtgtctccgc  
gacctgtcaaggccgtaacctttgtagcaaacacgacaccgatataatctggaacaagtatccagcctacgcgttcacctcacctacgagg  
gccagccgacaatatctaccgcgactacgaggagtggctcaacaaggataagctcaagaacctcatctggatacatgacaacctcgtcggag  
gaagcacgacatagttactacgacgacgagatgatcttctgtaggaacggctatggaagcaagcctggccttataacttacatcaacct  
cggctcgagcaaggttgaaggtgggtttacgttccgaagttcgcaggctcgtgcatacacgagtagacaccggcaatctcggcggtgggtgg  
acaagtgggtgactcaagcggctgggtctacctcgaggctcctgcccacgacccggccaacggccagtagcggtactccgtctggagctac  
tgcggtgttggtga

SEQ ID NO.: 44

Met Ala Lys Tyr Ser Glu Leu Glu Gly Gly Val Ile Met Gln Ala Phe Tyr Trp Asp Val Pro Gly  
Gly Gly Ile Trp Trp Asp Thr Ile Arg Ser Lys Ile Pro Glu Trp Tyr Glu Ala Gly Ile Ser Ala Ile Trp  
Ile Pro Pro Ala Ser Lys Gly Met Gly Gly Ala Tyr Ser Met Gly Tyr Asp Pro Tyr Asp Phe Phe Asp  
Leu Gly Glu Tyr Asp Gln Lys Gly Thr Val Glu Thr Arg Phe Gly Ser Lys Gln Glu Leu Val Asn  
Met Ile Asn Thr Ala His Ala Tyr Gly Ile Lys Val Ile Ala Asp Ile Val Ile Asn His Arg Ala Gly Gly  
Asp Leu Glu Trp Asn Pro Phe Val Gly Asp Tyr Thr Trp Thr Asp Phe Ser Lys Val Ala Ser Gly Lys  
Tyr Thr Ala Asn Tyr Leu Asp Phe His Pro Asn Glu Val Lys Cys Cys Asp Glu Gly Thr Phe Gly  
Gly Phe Pro Asp Ile Ala His Glu Lys Ser Trp Asp Gln His Trp Leu Trp Ala Ser Asp Glu Ser Tyr  
Ala Ala Tyr Leu Arg Ser Ile Gly Val Asp Ala Trp Arg Phe Asp Tyr Val Lys Gly Tyr Gly Ala Trp  
Val Val Lys Asp Trp Leu Asp Trp Trp Gly Gly Trp Ala Val Gly Glu Tyr Trp Asp Thr Asn Val Asp  
Ala Leu Leu Asn Trp Ala Tyr Ser Ser Asp Ala Lys Val Phe Asp Phe Pro Leu Tyr Tyr Lys Met Asp  
Glu Ala Phe Asp Asn Lys Asn Ile Pro Ala Leu Val Ser Ala Leu Gln Asn Gly Gln Thr Val Val Ser  
Arg Asp Pro Phe Lys Ala Val Thr Phe Val Ala Asn His Asp Thr Asp Ile Ile Trp Asn Lys Tyr Pro  
Ala Tyr Ala Phe Ile Leu Thr Tyr Glu Gly Gln Pro Thr Ile Phe Tyr Arg Asp Tyr Glu Glu Trp Leu  
Asn Lys Asp Lys Leu Lys Asn Leu Ile Trp Ile His Asp Asn Leu Val Gly Gly Ser Thr Ser Ile Val  
Tyr Tyr Asp Ser Asp Glu Met Ile Phe Val Arg Asn Gly Tyr Gly Ser Lys Pro Gly Leu Ile Thr Tyr  
Ile Asn Leu Gly Ser Ser Lys Val Gly Arg Trp Val Tyr Val Pro Lys Phe Ala Gly Ser Cys Ile His  
Glu Tyr Thr Gly Asn Leu Gly Gly Trp Val Asp Lys Trp Val Asp Ser Ser Gly Trp Val Tyr Leu Glu  
Ala Pro Ala His Asp Pro Ala Asn Gly Gln Tyr Gly Tyr Ser Val Trp Ser Tyr Cys Gly Val Gly

SEQ ID NO.: 45

atggccaagtactccgacctggaagagggcggcggtataatgcaggccttctactgggacgtcccaggtggaggaatctggtgggacaccat  
caggagcaagataccggagtggtacgagggcgggaatatccgccatttggattccccggcgagcaagggcatggcgggcgccctattcgatg  
ggctacgacccctacgacttcttgacctcggtagtacgaccagaagggaacggtagagacgcgtttggctccaagcaggagctcgtgaa  
catgataaacacggcccatgcctacggcataaaggtcatagcggacatcgtcataaaccaccgcgcaggcggagacctcgagtgaacccg  
ttcgttggggactacacctggacggacttctcaaaggtggcctcgggcaaatatactccaactacctcgacttccacccaacgagggtcaagt  
gctgtgacgagggcacatttggaggcttcccagacatagcccacgagaagagctgggaccagcactggctctgggcgagcgatgagagcta  
cgccgcctactaaggagcatcggtgatgcctggcgctttgactacgtgaagggtacggagcgtgggtcgtcaaggactggctcaactg  
gtggggcggtggcggttggcgagtactgggacaccaacgttgatgcactcctcaactgggcctactcgagcgcgccaaggtcttcgactt  
ccgcctctactacaagatggatgaggcctttgacaacaaaacattccagcgcctcgtctcgtccctcagaacggccagactgtgtctccgcg  
accgttcaaggccgtaacctttgtagcaaacacgacaccgatataatctggaacaagtatccagcctacgcgttcacctcacctacgaggg  
ccagccgacaatatctaccgcgactacgaggagtggctcaacaaggataagctcaagaacctcatctggatacatgacaacctcgcggag

Figure 16R



gaagcaccgacatagtctactacgataacgatgaactcatcttcgtcaggaacggctacggggacaagccggggccttataacctacatcaacct  
aggctcgagcaaggccggaaggtgggttatgtgccgaagttcgcgggcgctgcatccacgagtatactggtaacctcggaggctgggtag  
acaagtacgtctactcaagcggtgggtctatctgaagctccagcttacgacctgccaacgggcagtatggctactccgtgtggagctattgc  
gggtgtgggtga

SEQ ID NO.: 46

Met Ala Lys Tyr Ser Asp Leu Glu Glu Gly Gly Val Ile Met Gln Ala Phe Tyr Trp Asp Val Pro Gly  
Gly Gly Ile Trp Trp Asp Thr Ile Arg Ser Lys Ile Pro Glu Trp Tyr Glu Ala Gly Ile Ser Ala Ile Trp  
Ile Pro Pro Ala Ser Lys Gly Met Gly Gly Ala Tyr Ser Met Gly Tyr Asp Pro Tyr Asp Phe Phe Asp  
Leu Gly Glu Tyr Asp Gln Lys Gly Thr Val Glu Thr Arg Phe Gly Ser Lys Gln Glu Leu Val Asn  
Met Ile Asn Thr Ala His Ala Tyr Gly Ile Lys Val Ile Ala Asp Ile Val Ile Asn His Arg Ala Gly Gly  
Asp Leu Glu Trp Asn Pro Phe Val Gly Asp Tyr Thr Trp Thr Asp Phe Ser Lys Val Ala Ser Gly Lys  
Tyr Thr Ala Asn Tyr Leu Asp Phe His Pro Asn Glu Val Lys Cys Cys Asp Glu Gly Thr Phe Gly  
Gly Phe Pro Asp Ile Ala His Glu Lys Ser Trp Asp Gln His Trp Leu Trp Ala Ser Asp Glu Ser Tyr  
Ala Ala Tyr Leu Arg Ser Ile Gly Val Asp Ala Trp Arg Phe Asp Tyr Val Lys Gly Tyr Gly Ala Trp  
Val Val Lys Asp Trp Leu Asn Trp Trp Gly Gly Trp Ala Val Gly Glu Tyr Trp Asp Thr Asn Val Asp  
Ala Leu Leu Asn Trp Ala Tyr Ser Ser Gly Ala Lys Val Phe Asp Phe Pro Leu Tyr Tyr Lys Met Asp  
Glu Ala Phe Asp Asn Lys Asn Ile Pro Ala Leu Val Ser Ala Leu Gln Asn Gly Gln Thr Val Val Ser  
Arg Asp Pro Phe Lys Ala Val Thr Phe Val Ala Asn His Asp Thr Asp Ile Ile Trp Asn Lys Tyr Pro  
Ala Tyr Ala Phe Ile Leu Thr Tyr Glu Gly Gln Pro Thr Ile Phe Tyr Arg Asp Tyr Glu Glu Trp Leu  
Asn Lys Asp Lys Leu Lys Asn Leu Ile Trp Ile His Asp Asn Leu Ala Gly Gly Ser Thr Asp Ile Val  
Tyr Tyr Asp Asn Asp Glu Leu Ile Phe Val Arg Asn Gly Tyr Gly Asp Lys Pro Gly Leu Ile Thr Tyr  
Ile Asn Leu Gly Ser Ser Lys Ala Gly Arg Trp Val Tyr Val Pro Lys Phe Ala Gly Ala Cys Ile His  
Glu Tyr Thr Gly Asn Leu Gly Gly Trp Val Asp Lys Tyr Val Tyr Ser Ser Gly Trp Val Tyr Leu Glu  
Ala Pro Ala Tyr Asp Pro Ala Asn Gly Gln Tyr Gly Tyr Ser Val Trp Ser Tyr Cys Gly Val Gly

SEQ ID NO.: 47

atggccaagtacaccgagctggaagagggcggtgtataatgcaggccttctactgggacgtcccagggtggaggaatctgggtggacaccat  
caggagcaagataccggagtgtacgagggcggaatatccgccatttgattccccggcgagcaagggtatggcgggcgctattcgtatg  
ggctacgaccctacgaattctttgacctcggtagtacgaccagaagggaaacggtagagacgcgctttggctccaagcaggagctcgtgaa  
catgataaacaccgcccacgcctatggcatgaaggtaatagccgatatagtcatcaaccaccgcgccggcggtgacctggagtgaacccctt  
cgtgaacgactatacttgaccgacttctcaaaggtcgcgtcggttaatacacggccaactacctgacttccacccaacgaggtcaagt  
ctgtgacgagggcacatttgaggcttcccagacatagcccacgagaagagctgggaccagcactggctctggcgagcgatgagagctac  
gccgcctacctaaggagcatcggttgatgccttggtgctttgactacgtgaagggctacggagcgtgggtcgtaaggactggctcaactgg  
tggggcggttggcggttggtgagctactgggacaccaacgttgatgactcctcaactgggcctactcgagcggcgccaaggtcttcgacttc  
ccgctctactacaagatggatgaggcctttgacaacaaaaacattccagcgcctcgtctccttcagaacggccagactgtgtctccgcga  
ccggttcaaggccgtaaccttttagcaaacacgacacccgataataatctggaacaagtaccttgcttatgctttcatcctcacctacgaaggcca  
gcccgtcatattctaccgcgactacgaggagtggctcaacaaggacaggttgaaacacctcatatggatacacgaccacctcgagggtggaag  
cacgagcatagttactacgacagcgacgagatgatctcgtgaggaaacggctatggaagcaagcctggccttataacttacatcaacctcggt  
cgagcaaggttggaaggtgggttacgtccgaagttcgagggcgtgcatacacgagtacaccggcaatctcggcggtgggtggacaag  
tgggtggactcaagcggttggtctacctcgaggtcctgcccacgaccggccaacggccagtagcgctactccgtctggagctactcggtg  
tgttggttag

SEQ ID NO.: 48

Met Ala Lys Tyr Thr Glu Leu Glu Glu Gly Gly Val Ile Met Gln Ala Phe Tyr Trp Asp Val Pro Gly  
Gly Gly Ile Trp Trp Asp Thr Ile Arg Ser Lys Ile Pro Glu Trp Tyr Glu Ala Gly Ile Ser Ala Ile Trp  
Ile Pro Pro Ala Ser Lys Gly Met Gly Gly Ala Tyr Ser Met Gly Tyr Asp Pro Tyr Asp Phe Phe Asp  
Leu Gly Glu Tyr Asp Gln Lys Gly Thr Val Glu Thr Arg Phe Gly Ser Lys Gln Glu Leu Val Asn  
Met Ile Asn Thr Ala His Ala Tyr Gly Met Lys Val Ile Ala Asp Ile Val Ile Asn His Arg Ala Gly Gly  
Asp Leu Glu Trp Asn Pro Phe Val Asn Asp Tyr Thr Trp Thr Asp Phe Ser Lys Val Ala Ser Gly Lys

Figure 16S



Tyr Thr Ala Asn Tyr Leu Asp Phe His Pro Asn Glu Val Lys Cys Cys Asp Glu Gly Thr Phe Gly  
Gly Phe Pro Asp Ile Ala His Glu Lys Ser Trp Asp Gln His Trp Leu Trp Ala Ser Asp Glu Ser Tyr  
Ala Ala Tyr Leu Arg Ser Ile Gly Val Asp Ala Trp Arg Phe Asp Tyr Val Lys Gly Tyr Gly Ala Trp  
Val Val Lys Asp Trp Leu Asn Trp Trp Gly Gly Trp Ala Val Gly Glu Tyr Trp Asp Thr Asn Val Asp  
Ala Leu Leu Asn Trp Ala Tyr Ser Ser Gly Ala Lys Val Phe Asp Phe Pro Leu Tyr Tyr Lys Met Asp  
Glu Ala Phe Asp Asn Lys Asn Ile Pro Ala Leu Val Ser Ala Leu Gln Asn Gly Gln Thr Val Val Ser  
Arg Asp Pro Phe Lys Ala Val Thr Phe Val Ala Asn His Asp Thr Asp Ile Ile Trp Asn Lys Tyr Leu  
Ala Tyr Ala Phe Ile Leu Thr Tyr Glu Gly Gln Pro Val Ile Phe Tyr Arg Asp Tyr Glu Glu Trp Leu  
Asn Lys Asp Arg Leu Asn Asn Leu Ile Trp Ile His Asp His Leu Ala Gly Gly Ser Thr Ser Ile Val  
Tyr Tyr Asp Ser Asp Glu Met Ile Phe Val Arg Asn Gly Tyr Gly Ser Lys Pro Gly Leu Ile Thr Tyr  
Ile Asn Leu Gly Ser Ser Lys Val Gly Arg Trp Val Tyr Val Pro Lys Phe Ala Gly Pro Cys Ile His  
Glu Tyr Thr Gly Asn Leu Gly Gly Trp Val Asp Lys Trp Val Asp Ser Ser Gly Trp Val Tyr Leu Glu  
Ala Pro Ala His Asp Pro Ala Asn Gly Gln Tyr Gly Tyr Ser Val Trp Ser Tyr Cys Gly Val Gly

SEQ ID NO.: 53

ATGGCCAAGTACTCCGAGCTGGAAGAGGGCGGCGTTATAATGCAGGCCTTCTACTGGG  
ACGTCCCAGGTGGAGGAATCTGGTGGGACACCATCAGGAGCAAGATACCGGAGTGGT  
ACGAGGCGGGAATATCCGCCATTTGGATTCCCCCGGCGAGCAAGGGCATGGGCGGCG  
CCTATTTCGATGGGCTACGACCCCTACGACTTCTTTGACCTCGGTGAGTACGACCAGAA  
GGGAACGGTAGAGACGCGCTTTGGCTCCAAGCAGGAGCTCGTGAACATGATAAACAC  
GGCCCATGCCTACGGCATAAAGGTCATAGCGGACATCGTCATAAACCACCGCACAGGC  
GGAGACCTCGAGTGGAACCCGTTCTGTTGGGGACTACACCTGGACGGACTTCTCAAAGG  
TGGCCTCGGGCAAATATACTGCCAACTACCTCGACTTCCACCCCAACGAGGTCAAGTG  
CTGTGACGAGGGCACATTTGGAGGCTTCCCAGACATAGCCCACGAGAAGAGCTGGGA  
CCAGCACTGGCTCTGGGCGAGCGATGAGAGCTACGCCGCTACCTAAGGAGCATCGGC  
GTTGATGCCTGGCGCTTCGACTACGTCAAGGGCTACGGAGCGTGGGTCTGTCAGGACT  
GGCTGGACTGGTGGGGAGGCTGGGCCGTCGGGGAGTACTGGGACACAAACGTTGATG  
CACTGCTCAACTGGGCCTACTCGAGCGATGCAAAAGTCTTCGACTTCCCGCTCTACTAC  
AAGATGGATGAGGCCTTTGACAACAAAAACATTCCAGCGCTCGTCTCTGCCCTTCAGA  
ACGGCCAGACTGTTGTCTCCCGCGACCCGTTCAAGGCCGTAACCTTTGTAGCAAACCA  
CGACACCGATATAATCTGGAACAAGTATCCAGCCTACGCGTTCATCCTCACCTACGAG  
GGCCAGCCGACAATATTCTACCGGACTACGAGGAGTGGCTCAACAAGGATAAGCTCA  
AGAACCTCATCTGGATACATGACAACCTCGCCGGAGGAAGCACTGACATCGTTTACTA  
CGACAACGACGAGCTGATATTCGTGAGAAACGGCTACGGAAGCAAGCCGGGACTGAT  
AACATACATCAACCTCGCCTCAAGCAAAGCCGGAAGGTGGGTCTACGTTCCGAAGTTC  
GCGGGAGCGTGCATCCACGAGTACACCGGCAACCTCGGCGGCTGGGTGGACAAGTGG  
GTGGACTCAAGCGGGTGGGTGTACCTCGAGGCCCCTGCCACGACCCGGCCAACGGCT  
ATTACGGCTACTCCGTCTGGAGCTACTGCGGTGTTGGCTGA

SEQ ID NO.: 54

MAKYSELEEGVIMQAFYWDVPGGGIWWDITIRSKIPEWYEAGISAIWIPPASKGMGGAYS  
MGYDPYDFFDLGEYDQKGTVETFRGSKQELVNMINTAHAYGIKVIADIVINHRTGGDLEW  
NPFVGDYTWDFSKVASGKYTANYLDFHPNEVKCCDEGTFGGFPDIAHEKSWDQHWLW  
ASDESYAAYLRSIGVDAWRFDYVKGYGAWVVKDWLDWWGGWAVGEYWDTNVDALL  
NWAYSSDAKVFDPLYYKMDEAFDNKNIPALVSALQNGQTVVSRDPFKA VTFVANHDT  
IWNKYPAYAFILTYEGOPTIFYRDYEEWLNKDKLKNLIWIHDNLGGSTDIVYYDNDELIF  
VRNGYGSKPGLITYINLASSKAGRWWVYPKFAGACIHEYTGNLGGWVDKWVDSSGWVY  
LEAPAHDPANGYYGYSVWSYCGVG

SEQ ID NO.: 55

Figure 16T



ATGGCCAAGTACCTGGAGCTCGAGGAGGGCGGGGTCATAATGCAGGCGTTCTACTGGG  
ACGTGCCTTCAGGAGGAATATGGTGGGACACAATACGGCAGAAGATACCGGAGTGGT  
ACGATGCCGGAATCTCCGCAATATGGATTCCCCCGCGAGCAAGGGCATGGGCGGCGC  
CTATTTCGATGGGCTACGACCCCTACGACTTCTTTGACCTCGGTGAGTACGACCAGAAG  
GGAACGGTAGAGACGCGCTTTGGCTCCAAGCAGGAGCTCGTGAACATGATAAACACC  
GCCCACGCCTATGGCATGAAGGTAATAGCCGATATAGTCATCAACCACCGCGCCGGCG  
GTGACCTGGAGTGGAACCCCTTCGTGAACGACTATACCTGGACCGACTTCTCAAAGGT  
CGCGTCGGGTAAATACACGGCCAACCTACCTCGACTTCCACCCGAACGAGCTCCATGCG  
GGCGATTCCGGAACATTTGGAGGCTATCCCGACATATGCCACGACAAGAGCTGGGACC  
AGTACTGGCTCTGGGCCAGCCAGGAGAGCTACGCGGCATATCTCAGGAGCATCGGCAT  
CGATGCCTGGCGCTTTGACTACGTGAAGGGCTACGGAGCGTGGGTCGTCAAGGACTGG  
CTCAACTGGTGGGGCGGCTGGGCGGTTGGCGAGTACTGGGACACCAACGTTGATGCAC  
TCCTCAACTGGGCCTACTCGAGCGGCGCCAAGGTCTTCGACTTCCCGCTCTACTACAAG  
ATGGATGAGGCCTTTGACAACAAAAACATTCCAGCGCTCGTCTCTGCCCTTCAGAACG  
GCCAGACTGTTGTCTCCCGCGACCCGTTCAAGGCCGTAACCTTTGTAGCAAACCACGA  
CACCGATATAATCTGGAACAAGTACCTTGCTTATGCTTTCATCCTCACCTACGAAGGCC  
AGCCCGTCATATTCTACCGCGACTACGAGGAGTGGCTCAACAAGGACAGGTTGAACAA  
CCTCATATGGATACACGACCACCTCGCAGGTGGAAGCACGAGCATAGTTTACTACGAC  
AGCGACGAGATGATCTTCGTGAGGAACGGCTATGGAAGCAAGCCTGGCCTTATAACTT  
ACATCAACCTCGGCTCGAGCAAGGTTGGAAGGTGGGTTTACGTTCCGAAGTTCGCAGG  
CTCGTGATACACGAGTACACCGGCAATCTCGGCGGCTGGGTGGACAAGTGGGTGGAC  
TCAAGCGGCTGGGTCTACCTCGAGGCTCCTGCCCACGACCCGGCCAACGGCCAGTACG  
GCTACTCCGTCTGGAGCTATTGCGGTGTTGGCTGA

SEQ ID NO.: 56

MAKYLELEEGGVIMQAFYWDVPSGGIWWDTIRQKIPEWYDAGISAIWIPPASKGMGGAYS  
MGYDPYDFDLGEYDQKGTVETRFSGSKQELVNMINTAHAYGMKVIADIVINHRAGGDLE  
WNPVFVNDYTWDFSKVASGKYTANYLDFHPNELHAGDSGTFGGYPDICHDKSWDQYWL  
WASQESYAAYLRSIGIDAWRFDYVKGYGAWVVKDWLNWWGGWAVGEYWDTNVDALL  
NWAYSSGAKVDFDFLYYKMDEAFDNKNIPALVSALQNGQTVVSRDPKAVTFVANHDT  
IHWNKYLAFAILITYEGQPVIFYRDYEEWLNKDRLNLIWIHDHLAGGSTSIVYYDSDEMIF  
VRNGYGSKPLITYINLGSSKVGWRWVYVPKFAGSCIHEYTGNLGGWVDKWVDSSGWVYL  
EAPAHDPANGQYGYSVWSYCGVG

SEQ ID NO.: 57

ATGGCCAAGTACCTGGAGCTCGAAGAGAGCGGGGTCATAATGCAGGCGTTCTACTGGG  
ACGTGCCTTCAGGAGGAATATGGTGGGACACAATACGGCAGAAGATACCGGAGTGGT  
ACGATGCCGGAATCTCCGCAATATGGATTCTCCCGCGAGCAAGGGTATGAGCGGCGG  
CTATTTCGATGGGCTACGACCCCTACGATTATTTTGACCTCGGTGAGTACTACCAGAAG  
GAACGGTGGAACGAGGTTTCGGCTCAAAGCAGGAGCTCATAAACATGATAAACACCG  
CCCACGCCTACGGCATCAAGGTATCGCAGACATAGTAATCAACCACCGCGCCGGAGG  
AGACCTTGAGTGGAACCCCTTCGTCAATGACTACACCTGGACCGACTTCTCGAAGGTC  
GCTTCCGGCAAGTACACGGCCAACCTACCTCGACTTCCACCCCAACGAGGTCAAGTGCT  
GTGACGAGGGGCACATTTGGAGGCTTCCCAGACATAGCCACGAGAAGAGCTGGGACC  
AGCACTGGCTCTGGGCGAGCGATGAGAGCTACGCCGCCTACCTAAGGAGCATCGGCGT  
TGATGCCTGGCGCTTTGACTACGTGAAGGGCTACGGAGCGTGGGTCGTCAAGGACTGG  
CTCAACTGGTGGGGTGGCTGGGCGGTCGGGGAGTACTGGGACACAAACGTTGATGCAC  
TGCTCAACTGGGCCTACTCGAGCGATGCAAAAGTCTTCGACTTCCCGCTCTACTACAAG  
ATGGACGAGGCCTTCGATAACAACAACATTCCCGCCCTGGTGGACGCCCTCAGATACG  
GTCAGACAGTGGTCAGCCGCGACCCGTTCAAGGCTGTGACGTTTGTAGCCAACCACGA

Figure 16U



CCGATATAATCTGGAACAAGTACCTTGCTTATGCTTTTCATCCTCACCTACGAAGGCC  
AGCCCGTCATATTCTACCGCGACTACGAGGAGTGGCTCAACAAGGACAGGTTGAACAA  
CCTCATATGGATACACGACCACCTCGCAGGTGGAAGCACTGACATCGTTTACTACGAC  
AACGACGAGCTGATATTCGTGAGAAACGGCTACGGAAGCAAGCCGGGACTGATAACA  
TACATCAACCTCGCCTCAAGCAAAGCCGGAAGGTGGGTCTACGTTCCGAAGTTCGCGG  
GAGCGTGCATCCACGAGTACACCGGCAACCTCGGCGGCTGGGTGGACAAGTGGGTGG  
ACTCAAGCGGGTGGGTGTACCTCGAGGCCCTGCCACGACCCGGCCAACGGCTATTA  
CGGCTACTCCGTCTGGAGCTATTGCGGTGTTGGCTGA

SEQ ID NO.: 58

MAKYLELEESGVIMQAFYWDVPSGGIWWDTIRQKIPEWYDAGISAIWIPPASKGMSGGYS  
MGYDPYDYFDLGEYYQKGTVETRFGSKQELINMINTAHAYGIKVIADIVINHRAGGDLEW  
NPFVNDYTWTDFSKVASGKYTANYLDFHPNEVKCCDEGTFGGFPDIAHEKSWDQHWLW  
ASDESYAAYLRSIGVDAWRFDYVKGYGAWVVKDWLNWWGGWAVGEYWDTNVDALL  
NWAYSSDAKVDFPLYKMDAEDNINNIPALVDALRYGQTVVSRDPFKA VTFVANHDTD  
IWNKYLAYAFILTYEQPVIFYRDYEEWLNKDRLNLIWIHDHLAGGSTDIVYYDNDELIF  
VRNGYGSKPGLITYINLASSKAGRWVYVPKFAGACIHEYTG NLGGWVDKWVDSSGWVY  
LEPAHDPANGYYGYSVWSYCGVG

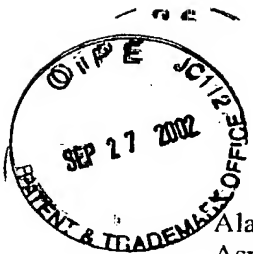
SEQ ID NO.: 59

atggccaagtacctggagctcgaagagggcggggtcataatgcaggcgttctactgggacgtgccttcaggaggaatatggtgggacacaat  
acggcagaagataccggagtggtacgatccggaatctccgcaatatggattctcccgagcaagggtatgagcggcggctattcgatgg  
gctacgaccctacgattatttgacctcggtgagtactaccagaagggaacgggtgaaacgaggttcggctcaaagcaggagctcataaacat  
gataaacaccgcccacgctacggcatcaaggtcatcgagacatagtaataaccaccgcccggaggagacctgagtgaaccccttcg  
tcaatgactacacctggacggacttctgaaggtcgcttcggcaagtacacggccaactacctcgactccaccggaacgagctccatcg  
gcatctcaggagcatcgccatcgatgcctggcgttcgactacgtcaagggtatgctccctgggtcgaaggactggctgaactggtggg  
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cgttaaggctgtgacgtttgtagccaaccacgataccgatataatttgaacaagtaccggcctacgccttcacctcactacgagggccag  
ccgacgatattctaccgcgactacgaggagtggctcaacaaggacagggtcaagaacctcatctggatacacgaccacctcgccggtggaag  
cactgacatcgtttactacgacaacgacgagctgatattcgtgagaaacgggtacggaagcaagccgggactgataacatacatcaacctcgc  
gtcaagcaaagccggaaggtgggtttatgtgccgaaggtcgcgggcgctgcatccacgagtatactggaacctcggaggtgggtagaca  
agtacgtctactcaagcgggtgggtctatctgaagctccagcttacgacctgccaacgggcagtatggctactccgtgtggagctattcggt  
gttgggtga

SEQ ID NO.: 60

Met Ala Lys Tyr Leu Glu Leu Glu Gly Gly Val Ile Met Gln Ala Phe Tyr Trp Asp Val Pro Ser  
Gly Gly Ile Trp Trp Asp Thr Ile Arg Gln Lys Ile Pro Glu Trp Tyr Asp Ala Gly Ile Ser Ala Ile Trp  
Ile Pro Pro Ala Ser Lys Gly Met Ser Gly Gly Tyr Ser Met Gly Tyr Asp Pro Tyr Asp Tyr Phe Asp  
Leu Gly Glu Tyr Tyr Gln Lys Gly Thr Val Glu Thr Arg Phe Gly Ser Lys Gln Glu Leu Ile Asn Met  
Ile Asn Thr Ala His Ala Tyr Gly Ile Lys Val Ile Ala Asp Ile Val Ile Asn His Arg Ala Gly Gly Asp  
Leu Glu Trp Asn Pro Phe Val Asn Asp Tyr Thr Trp Thr Asp Phe Ser Lys Val Ala Ser Gly Lys Tyr  
Thr Ala Asn Tyr Leu Asp Phe His Pro Asn Glu Leu His Ala Gly Asp Ser Gly Thr Phe Gly Gly Tyr  
Pro Asp Ile Cys His Asp Lys Ser Trp Asp Gln Tyr Trp Leu Trp Ala Ser Gln Glu Ser Tyr Ala Ala  
Tyr Leu Arg Ser Ile Gly Ile Asp Ala Trp Arg Phe Asp Tyr Val Lys Gly Tyr Ala Pro Trp Val Val  
Lys Asp Trp Leu Asn Trp Trp Gly Gly Trp Ala Val Gly Glu Tyr Trp Asp Thr Asn Val Asp Ala Val  
Leu Asn Trp Ala Tyr Ser Ser Gly Ala Lys Val Phe Asp Phe Ala Leu Tyr Tyr Lys Met Asp Glu Ala  
Phe Asp Asn Asn Asn Ile Pro Ala Leu Val Asp Ala Leu Arg Tyr Gly Gln Thr Val Val Ser Arg Asp  
Pro Phe Lys Ala Val Thr Phe Val Ala Asn His Asp Thr Asp Ile Ile Trp Asn Lys Tyr Pro Ala Tyr

Figure 16V



Ala Phe Ile Leu Thr Tyr Glu Gly Gln Pro Thr Ile Phe Tyr Arg Asp Tyr Glu Glu Trp Leu Asn Lys  
Asp Arg Leu Lys Asn Leu Ile Trp Ile His Asp His Leu Ala Gly Gly Ser Thr Asp Ile Val Tyr Tyr  
Asp Asn Asp Glu Leu Ile Phe Val Arg Asn Gly Tyr Gly Ser Lys Pro Gly Leu Ile Thr Tyr Ile Asn  
Leu Ala Ser Ser Lys Ala Gly Arg Trp Val Tyr Val Pro Lys Phe Ala Gly Ala Cys Ile His Glu Tyr  
Thr Gly Asn Leu Gly Gly Trp Val Asp Lys Tyr Val Tyr Ser Ser Gly Trp Val Tyr Leu Glu Ala Pro  
Ala Tyr Asp Pro Ala Asn Gly Gln Tyr Gly Tyr Ser Val Trp Ser Tyr Cys Gly Val Gly

SEQ ID NO.: 61

atggccaagtactccgagctgaaaaagggcgggggtcataatgcaggcgttctactgggacgtgccttcaggaggaatatgggtgggacacaat  
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gctacgaccctacgattattttgacctcggtagtactaccagaagggaacgggtgaaacgaggttcggctcaaagcaggagctcataaacat  
gataaacaccgcccacgctacggcatcaaggatcgcagacatagtaataccaccgcgcggaggagaccttgagtggaaaccttcg  
tcaatgactacacctggacggacttctgaaggctcgttcggcaagtacacggccaactacctcaactccaccggaacgagctccatgcgg  
gcatctccggaacatttgagggtatcccgacatatgccacgacaagagctgggaccagtactggctctgggccagccaggagagctacgcg  
gcatatctcaggagcatcggcatcgtgctggcgcttcgactacgtcaagggtacggagcgtgggtcgtcaaggactggctggactgggtg  
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gctctactacaagatggatgaggcctttgacaacaaaaacattccagcgtcgtctctgccttcagaacggccagactgttctctccgcgacc  
cgttcaaggccgtaaccttttagcaaacatgacaccgatataatctggaacaagtatccagcctacgcgttcacctcacctacgaggggccag  
ccgacaatattctaccgcgactacgaggagtggtcaacaagataagctcaagaacctcatctggatacatgacaacctcgccggaggaag  
caccgacatagctactacgataacgatgaactcatctcgtcaggaaacgggtacggggacaagccggggcttataacctacatcaacctagggc  
tcgagcaaggccggaaggtgggttacgttccgaagttcgcgggagcgtgcatccacgagtagaccggcaacctcgccggctgggtggaca  
agtgggtggactcaagcgggtgggtgtacctcgaggccctgccacgaccggccaacggctattacggctactcgtctggagctactgc  
gggtgggtgta

SEQ ID NO.: 62

Met Ala Lys Tyr Ser Glu Leu Lys Lys Gly Gly Val Ile Met Gln Ala Phe Tyr Trp Asp Val Pro Ser  
Gly Gly Ile Trp Trp Asp Thr Ile Arg Gln Lys Ile Pro Glu Trp Tyr Glu Ala Gly Ile Ser Ala Ile Trp  
Ile Pro Pro Ala Ser Lys Gly Met Ser Gly Gly Tyr Ser Met Gly Tyr Asp Pro Tyr Asp Tyr Phe Asp  
Leu Gly Glu Tyr Tyr Gln Lys Gly Thr Val Glu Thr Arg Phe Gly Ser Lys Gln Glu Leu Ile Asn Met  
Ile Asn Thr Ala His Ala Tyr Gly Ile Lys Val Ile Ala Asp Ile Val Ile Asn His Arg Ala Gly Gly Asp  
Leu Glu Trp Asn Pro Phe Val Asn Asp Tyr Thr Trp Thr Asp Phe Ser Lys Val Ala Ser Gly Lys Tyr  
Thr Ala Asn Tyr Leu Asn Phe His Pro Asn Glu Leu His Ala Gly Asp Ser Gly Thr Phe Gly Gly Tyr  
Pro Asp Ile Cys His Asp Lys Ser Trp Asp Gln Tyr Trp Leu Trp Ala Ser Gln Glu Ser Tyr Ala Ala  
Tyr Leu Arg Ser Ile Gly Ile Asp Ala Trp Arg Phe Asp Tyr Val Lys Gly Tyr Gly Ala Trp Val Val  
Lys Asp Trp Leu Asp Trp Trp Gly Gly Trp Ala Val Gly Glu Tyr Trp Asp Thr Asn Val Asp Ala  
Leu Leu Asn Trp Ala Tyr Ser Ser Asp Ala Lys Val Phe Asp Phe Pro Leu Tyr Tyr Lys Met Asp Glu  
Ala Phe Asp Asn Lys Asn Ile Pro Ala Leu Val Ser Ala Leu Gln Asn Gly Gln Thr Val Val Ser Arg  
Asp Pro Phe Lys Ala Val Thr Phe Val Ala Asn His Asp Thr Asp Ile Ile Trp Asn Lys Tyr Pro Ala  
Tyr Ala Phe Ile Leu Thr Tyr Glu Gly Gln Pro Thr Ile Phe Tyr Arg Asp Tyr Glu Glu Trp Leu Asn  
Lys Asp Lys Leu Lys Asn Leu Ile Trp Ile His Asp Asn Leu Ala Gly Gly Ser Thr Asp Ile Val Tyr  
Tyr Asp Asn Asp Glu Leu Ile Phe Val Arg Asn Gly Tyr Gly Asp Lys Pro Gly Leu Ile Thr Tyr Ile  
Asn Leu Gly Ser Ser Lys Ala Gly Arg Trp Val Tyr Val Pro Lys Phe Ala Gly Ala Cys Ile His Glu  
Tyr Thr Gly Asn Leu Gly Gly Trp Val Asp Lys Trp Val Asp Ser Ser Gly Trp Val Tyr Leu Glu Ala  
Pro Ala His Asp Pro Ala Asn Gly Tyr Tyr Gly Tyr Ser Val Trp Ser Tyr Cys Gly Val Gly

SEQ ID NO.: 63

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ggctacgaccctacgacttctttgacctcggtagtactaccagaagggaacggtagagacgcgtttggctccaagcaggagctcgtgaa  
catgataaacacggcccatgcctacggcataaaggccatagcggacatcgtcataaaccaccgcgcaggcggagacctcgagtggaaacctg

Figure 16W

ttcgttggggactacacctggacggacttctcaaaggtggcctcgggcaaataactgccaactacctcgacttccaccccaacgagggtcaagt  
gctgtgacgagggcacatttggaggttcccagacatagcccacgagaagagctgggaccagcactggctctgggcgagcgatgagagcta  
cgccgectacctaaggagcatcggcgttgatgcctggcgctttgactacgtgaagggtacggagcgtgggtcgtaaggactggctcaactg  
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gcgacccgttaaggccgtaaccttctgttcaaaccacgacaccgataatctggaacaagtatccagcctacgcgttcactcctacacacgag  
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aggaagcaccgacatagtctactacgataacgatgaactcatcttctcagggaacggctacggggacaagccgggggttataacctacatcaa  
cctaggctggagcaaggccggaagggtgggtttatgtgccgaagttcggggcggtgcatccacgagataactggtaacctcgagggtggg  
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ctgcgggggtggggtga

SEQ ID NO.: 64

Met Ala Lys Tyr Leu Glu Leu Glu Gly Gly Val Ile Met Gln Ala Phe Tyr Trp Asp Val Pro Ser  
Gly Gly Ile Trp Trp Asp Thr Ile Arg Gln Lys Ile Pro Glu Trp Tyr Asp Ala Gly Ile Ser Ala Ile Trp  
Ile Pro Pro Ala Ser Lys Gly Met Gly Gly Ala Tyr Ser Met Gly Tyr Asp Pro Tyr Asp Phe Phe Asp  
Leu Gly Glu Tyr Asp Gln Lys Gly Thr Val Glu Thr Arg Phe Gly Ser Lys Gln Glu Leu Val Asn  
Met Ile Asn Thr Ala His Ala Tyr Gly Ile Lys Ala Ile Ala Asp Ile Val Ile Asn His Arg Ala Gly Gly  
Asp Leu Glu Trp Asn Pro Phe Val Gly Asp Tyr Thr Trp Thr Asp Phe Ser Lys Val Ala Ser Gly Lys  
Tyr Thr Ala Asn Tyr Leu Asp Phe His Pro Asn Glu Val Lys Cys Cys Asp Glu Gly Thr Phe Gly  
Gly Phe Pro Asp Ile Ala His Glu Lys Ser Trp Asp Gln His Trp Leu Trp Ala Ser Asp Glu Ser Tyr  
Ala Ala Tyr Leu Arg Ser Ile Gly Val Asp Ala Trp Arg Phe Asp Tyr Val Lys Gly Tyr Gly Ala Trp  
Val Val Lys Asp Trp Leu Asn Trp Trp Gly Gly Trp Ala Val Gly Glu Tyr Trp Asp Thr Asn Val Asp  
Ala Leu Leu Asn Trp Ala Tyr Ser Ser Gly Ala Lys Val Phe Asp Phe Pro Leu Tyr Tyr Lys Met Asp  
Ala Ala Phe Asp Asn Lys Asn Ile Pro Ala Leu Val Glu Ala Leu Lys Asn Gly Gly Thr Val Val Ser  
Arg Asp Pro Phe Lys Ala Val Thr Phe Val Ala Asn His Asp Thr Asp Ile Ile Trp Asn Lys Tyr Pro  
Ala Tyr Ala Phe Ile Leu Thr Tyr Glu Gly Gln Pro Thr Ile Phe Tyr Arg Asp Tyr Glu Glu Trp Leu  
Asn Lys Asp Lys Leu Lys Asn Leu Ile Trp Ile His Asp Asn Leu Ala Gly Gly Ser Thr Asp Ile Val  
Tyr Tyr Asp Asn Asp Glu Leu Ile Phe Val Arg Asn Gly Tyr Gly Asp Lys Pro Gly Leu Ile Thr Tyr  
Ile Asn Leu Gly Trp Ser Lys Ala Gly Arg Trp Val Tyr Val Pro Lys Phe Ala Gly Ala Cys Ile His  
Glu Tyr Thr Gly Asn Leu Gly Gly Trp Val Asp Lys Tyr Val Tyr Ser Ser Gly Trp Val Tyr Leu Glu  
Ala Pro Ala Tyr Asp Pro Ala Asn Gly Gln Tyr Gly Tyr Ser Val Trp Ser Tyr Cys Gly Val Gly

SEQ ID NO.: 65

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gctacgaccctacgattatttgacctcgggtgagtactaccagaagggaacgggtggaacgaggttcggctcaaagcaggagctcataaacat  
gataaacaccgcccacgcctatggcatgaaggtaatagccgatatagtcatcaaccaccgcgccggcggtgacctggagtgaaccccttctg  
gaacgactatactggaccgacttctcaaaggctcgctcgggtaatacacggccaactacctcgacttccacccgaacgagctccatcgggg  
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gttggctga

Figure 16X



## SEQ ID NO.: 66

Met Ala Lys Tyr Ser Glu Leu Glu Gly Gly Val Ile Met Gln Ala Phe Tyr Trp Asp Val Pro Gly  
Gly Gly Ile Trp Trp Gly Thr Ile Arg Ser Lys Ile Pro Glu Trp Tyr Glu Ala Gly Ile Ser Ala Ile Trp Ile  
Pro Pro Ala Ser Lys Gly Met Ser Gly Gly Tyr Ser Met Gly Tyr Asp Pro Tyr Asp Tyr Phe Asp Leu  
Gly Glu Tyr Tyr Gln Lys Gly Thr Val Glu Thr Arg Phe Gly Ser Lys Gln Glu Leu Ile Asn Met Ile  
Asn Thr Ala His Ala Tyr Gly Met Lys Val Ile Ala Asp Ile Val Ile Asn His Arg Ala Gly Gly Asp  
Leu Glu Trp Asn Pro Phe Val Asn Asp Tyr Thr Trp Thr Asp Phe Ser Lys Val Ala Ser Gly Lys Tyr  
Thr Ala Asn Tyr Leu Asp Phe His Pro Asn Glu Leu His Ala Gly Asp Ser Gly Thr Phe Gly Gly Tyr  
Pro Asp Ile Cys His Asp Lys Ser Trp Asp Gln Tyr Trp Leu Trp Ala Ser Gln Glu Ser Tyr Ala Ala  
Tyr Leu Arg Ser Ile Gly Ile Asp Ala Trp Arg Phe Asp Tyr Val Lys Gly Tyr Ala Pro Trp Val Val  
Lys Asp Trp Leu Asn Trp Trp Gly Gly Trp Ala Val Gly Glu Tyr Trp Asp Thr Asn Val Asp Ala Val  
Leu Asn Trp Ala Tyr Ser Ser Gly Ala Lys Val Phe Asp Phe Ala Leu Tyr Tyr Lys Met Asp Glu Ala  
Phe Asp Asn Asn Asn Ile Pro Ala Leu Val Asp Ala Leu Arg Tyr Gly Gln Thr Val Val Ser Arg Asp  
Pro Phe Lys Ala Val Thr Phe Val Ala Asn His Asp Thr Asp Ile Ile Trp Asn Lys Tyr Pro Ala Tyr  
Ala Phe Ile Leu Thr Tyr Glu Gly Gln Pro Thr Ile Phe Tyr Arg Asp Tyr Glu Glu Trp Leu Asn Lys  
Asp Arg Leu Lys Asn Leu Ile Trp Ile His Asp His Leu Ala Gly Gly Ser Thr Ser Ile Val Tyr Tyr  
Asp Ser Asp Glu Met Ile Phe Val Arg Asn Gly Tyr Gly Ser Lys Pro Gly Leu Ile Thr Tyr Ile Asn  
Leu Gly Ser Ser Lys Val Gly Arg Trp Val Tyr Val Pro Lys Phe Ala Gly Ser Cys Ile His Glu Tyr  
Thr Gly Asn Leu Gly Gly Trp Val Asp Lys Trp Val Asp Ser Ser Gly Trp Val Tyr Leu Glu Ala Pro  
Ala His Asp Pro Ala Asn Gly Gln Tyr Gly Tyr Ser Val Trp Ser Tyr Cys Gly Val Gly

## SEQ ID NO.: 67

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acggcagaagataccggagtggtacgatgccggaatctccgcaatatggattcctcccgcgagcaagggtatgagcggcggtctatcgatgg  
gctacgacctacgattatgtgacctcggtagtactaccagaagggaacgggtgaaacgaggttcggctcaaaagcaggagctcataaacat  
gataaacacggcccatgcctacggcataaaggatcatagcggacatcgctataaaccaccgcgcaggcggagacctcgagtggaaacccgttc  
gttggggactacacctggacggacttctcaaaagggtggcctcgggcaaatatactgccaactacctcgacttccacccaacgaggtcaagtgtc  
gtgacgagggcacatttgagggttccagacatagcccacgagaagagctgggaccagcactgggtctgggcgagcgatgagagctacg  
ccgctacctaaggagcatcggttgatgcctggcgcttcgactacgtcaagggtacggagcgtgggtcgtcaaggactgggtggactggt  
ggggagggtggggcgctggggagtactgggacacaaacgttgatgcactgctcaactgggctactcgagcgatgcaaaagtcttgacttc  
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gacctgtcaaggctgtgacgtttgtagccaaccacgataccgatataatctggaacaagtatccagcctacgcgttcacctcagctacgaggg  
ccagccgacaatattctaccgcgactacgaggagtgggtcaacaaggataagctcaagaacctcatctggatacatgacaacctcggcgag  
gaagcagcagcatagttactacgacagcgacgagatgatcttcgtgaggaacggctatggaagcaagcctggcctataacttacatcaacct  
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ctgcgtggtgggtga

## SEQ ID NO.: 68

Met Ala Lys Tyr Leu Glu Leu Glu Gly Gly Val Ile Met Gln Ala Phe Tyr Trp Asp Val Pro Ser  
Gly Gly Ile Trp Trp Asp Thr Ile Arg Gln Lys Ile Pro Glu Trp Tyr Asp Ala Gly Ile Ser Ala Ile Trp  
Ile Pro Pro Ala Ser Lys Gly Met Ser Gly Gly Tyr Ser Met Gly Tyr Asp Pro Tyr Asp Tyr Phe Asp  
Leu Gly Glu Tyr Tyr Gln Lys Gly Thr Val Glu Thr Arg Phe Gly Ser Lys Gln Glu Leu Ile Asn Met  
Ile Asn Thr Ala His Ala Tyr Gly Ile Lys Val Ile Ala Asp Ile Val Ile Asn His Arg Ala Gly Gly Asp  
Leu Glu Trp Asn Pro Phe Val Gly Asp Tyr Thr Trp Thr Asp Phe Ser Lys Val Ala Ser Gly Lys Tyr  
Thr Ala Asn Tyr Leu Asp Phe His Pro Asn Glu Val Lys Cys Cys Asp Glu Gly Thr Phe Gly Gly  
Phe Pro Asp Ile Ala His Glu Lys Ser Trp Asp Gln His Trp Leu Trp Ala Ser Asp Glu Ser Tyr Ala  
Ala Tyr Leu Arg Ser Ile Gly Val Asp Ala Trp Arg Phe Asp Tyr Val Lys Gly Tyr Gly Ala Trp Val  
Val Lys Asp Trp Leu Asp Trp Trp Gly Gly Trp Ala Val Gly Glu Tyr Trp Asp Thr Asn Val Asp Ala  
Leu Leu Asn Trp Ala Tyr Ser Ser Asp Ala Lys Val Phe Asp Phe Pro Leu Tyr Tyr Lys Met Asp Glu

Figure 16Y



Ala Phe Asp Asn Asn Asn Ile Pro Ala Leu Val Asp Ala Leu Arg Tyr Gly Gln Thr Val Val Ser Arg  
Asp Pro Phe Lys Ala Val Thr Phe Val Ala Asn His Asp Thr Asp Ile Ile Trp Asn Lys Tyr Pro Ala  
Tyr Ala Phe Ile Leu Thr Tyr Glu Gly Gln Pro Thr Ile Phe Tyr Arg Asp Tyr Glu Glu Trp Leu Asn  
Lys Asp Lys Leu Lys Asn Leu Ile Trp Ile His Asp Asn Leu Ala Gly Gly Ser Thr Ser Ile Val Tyr  
Tyr Asp Ser Asp Glu Met Ile Phe Val Arg Asn Gly Tyr Gly Ser Lys Pro Gly Leu Ile Thr Tyr Ile  
Asn Leu Gly Ser Ser Lys Val Gly Arg Trp Val Tyr Val Pro Lys Phe Ala Gly Ala Cys Ile His Glu  
Tyr Thr Gly Asn Leu Gly Gly Trp Val Asp Lys Trp Val Asp Ser Ser Gly Trp Val Tyr Leu Glu Ala  
Pro Ala His Asp Pro Ala Asn Gly Tyr Tyr Gly Tyr Ser Val Trp Ser Tyr Cys Val Val Gly

SEQ ID NO.: 73

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acgatttctcgacctcggtgagtactaccagaagggaagcgttgagaccgccttcggatcaaaagaggagcttgtaacatgataaacaccgc  
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ctggaccgatttctgaaggtcgcgtcgggcaagtacacggccaactacctcgacttccaccgaacgagcttcacgcgggcgattccggaa  
catttggaggctatcccgacatatgccacgacaagagctgggaccagcactggctctggccagcaacgaaagctacgccgctacctccgg  
agcatcggcacgcgctggcgttcgactacgtcaagggtacgctccctgggtcgttaagaactggctgaaccgggtggggcggtgggc  
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atggacgaggccttcgataacaacaacatccccgccctcgtggagcgcctcaagaacggaggcacggctgcagccgcgacccgttcaaag  
ccgtgaccttcgttccaaccacgataccaacataatctggaacaagtatccggcctacgccttcctcctacatagaggagacgccggcaat  
attctaccgcgactacgaggagtggctcaacaaggacaggtcaggaacctcatctggatacacgaccacctcgcgggaggaagcacagac  
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aaggccggaaggtgggtctacgttcgaagttcgcaggtcgtgcatacacgagtagaccggcaacctcggcggttgattgacaagtgggt  
tgactcaagcgggtcgggtctaccttgaggccccgccacgaccggccaacggccagtagcggtactccgtatggagctactcggtgttg  
ggtga

SEQ ID NO.: 74

Met Ala Leu Glu Glu Gly Gly Leu Ile Met Gln Ala Phe Tyr Trp Asp Val Pro Gly Gly Gly Ile Trp  
Trp Asp Thr Ile Ala Gln Lys Ile Pro Asp Trp Ala Ser Ala Gly Ile Ser Ala Ile Trp Ile Pro Pro Ala  
Ser Lys Gly Met Ser Gly Gly Tyr Ser Met Gly Tyr Asp Pro Tyr Asp Phe Phe Asp Leu Gly Glu Tyr  
Tyr Gln Lys Gly Ser Val Glu Thr Arg Phe Gly Ser Lys Glu Glu Leu Val Asn Met Ile Asn Thr Ala  
His Ala His Asn Met Lys Val Ile Ala Asp Ile Val Ile Asn His Arg Ala Gly Gly Asp Leu Glu Trp  
Asn Pro Phe Thr Asn Ser Tyr Thr Trp Thr Asp Phe Ser Lys Val Ala Ser Gly Lys Tyr Thr Ala Asn  
Tyr Leu Asp Phe His Pro Asn Glu Leu His Ala Gly Asp Ser Gly Thr Phe Gly Gly Tyr Pro Asp Ile  
Cys His Asp Lys Ser Trp Asp Gln His Trp Leu Trp Ala Ser Asn Glu Ser Tyr Ala Ala Tyr Leu Arg  
Ser Ile Gly Ile Asp Ala Trp Arg Phe Asp Tyr Val Lys Gly Tyr Ala Pro Trp Val Val Lys Asn Trp  
Leu Asn Arg Trp Gly Gly Trp Ala Val Gly Glu Tyr Trp Asp Thr Asn Val Asp Ala Leu Leu Ser Trp  
Ala Tyr Asp Ser Gly Ala Lys Val Phe Asp Phe Pro Leu Tyr Tyr Lys Met Asp Glu Ala Phe Asp  
Asn Asn Asn Ile Pro Ala Leu Val Asp Ala Leu Lys Asn Gly Gly Thr Val Val Ser Arg Asp Pro Phe  
Lys Ala Val Thr Phe Val Ala Asn His Asp Thr Asn Ile Ile Trp Asn Lys Tyr Pro Ala Tyr Ala Phe Ile  
Leu Thr Tyr Glu Gly Gln Pro Ala Ile Phe Tyr Arg Asp Tyr Glu Glu Trp Leu Asn Lys Asp Arg Leu  
Arg Asn Leu Ile Trp Ile His Asp His Leu Ala Gly Gly Ser Thr Asp Ile Ile Tyr Tyr Asp Ser Asp Glu  
Leu Ile Phe Val Arg Asn Gly Tyr Gly Asp Lys Pro Gly Leu Ile Thr Tyr Ile Asn Leu Gly Ser Ser  
Lys Ala Gly Arg Trp Val Tyr Val Pro Lys Phe Ala Gly Ser Cys Ile His Glu Tyr Thr Gly Asn Leu  
Gly Gly Trp Ile Asp Lys Trp Val Asp Ser Ser Gly Arg Val Tyr Leu Glu Ala Pro Ala His Asp Pro  
Ala Asn Gly Gln Tyr Gly Tyr Ser Val Trp Ser Tyr Cys Gly Val Gly

SEQ ID NO.: 75

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acccgactgggcaagcgccgggatttcggcatatggattcccccgagcaaggggtatgagcggcggtctattcgatgggctacgacctt

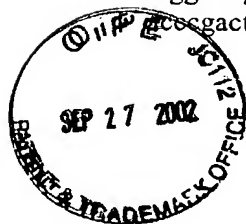


Figure 16Z

acgattattttgacctcgggtga gtactaccagaagggaacgggtgaaacaagattcggctcaaagcaggagctcataaacatgataaacaccg  
cccacgcctatggcatgaaggtaatagccgatatagtcatcaaccaccgcgccggcgatctggagtgaaccccttcgtgaacgactata  
cctggaccgacttctcgaaggctcgcgtcgggtaaatacacggccaactacctcgacttccacccgaacgagctccacgcgggcgattccgga  
acatttggaggctatcccgacatatgccacgacaagagctgggaccagtactggctctgggcccagccaggagagctacgcggcctatctcag  
gagcatcggcatcgacgcctggcgcttcgactacgtcaagggttatgctccctgggtcgtcagggactggctgaactggtggggaggctggg  
cagttggagagtactgggacaccaacgtcgacgctgttctcaactgggcatactcgagcgggtgccaaggctttgacttcgccctctactacaag  
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tgtgacgtttgtagccaaccacgataccgacataatctggaacaagtatccagcctacgcgttcacctcacctacgagggccagccgacaatat  
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gtttactacgacaacgacgagctgatattcgtgaaaacgggtacggaagcaagccgggactgataacatacatcaacctcggtcgaagcaa  
gccggaaggtgggtttacgttccgaagttcgcaggctcgtgcatacacgagtacaccggcaacctcggcggctgggtggacaagtgggtgga  
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SEQ ID NO.: 76

Met Ala Leu Glu Glu Gly Gly Leu Ile Met Gln Ala Phe Tyr Trp Asp Val Pro Met Gly Gly Ile Trp  
Trp Asp Thr Ile Ala Gln Lys Ile Pro Asp Trp Ala Ser Ala Gly Ile Ser Ala Ile Trp Ile Pro Pro Ala  
Ser Lys Gly Met Ser Gly Gly Tyr Ser Met Gly Tyr Asp Pro Tyr Asp Tyr Phe Asp Leu Gly Glu Tyr  
Tyr Gln Lys Gly Thr Val Glu Thr Arg Phe Gly Ser Lys Gln Glu Leu Ile Asn Met Ile Asn Thr Ala  
His Ala Tyr Gly Met Lys Val Ile Ala Asp Ile Val Ile Asn His Arg Ala Gly Gly Asp Leu Glu Trp  
Asn Pro Phe Val Asn Asp Tyr Thr Trp Thr Asp Phe Ser Lys Val Ala Ser Gly Lys Tyr Thr Ala Asn  
Tyr Leu Asp Phe His Pro Asn Glu Leu His Ala Gly Asp Ser Gly Thr Phe Gly Gly Tyr Pro Asp Ile  
Cys His Asp Lys Ser Trp Asp Gln Tyr Trp Leu Trp Ala Ser Gln Glu Ser Tyr Ala Ala Tyr Leu Arg  
Ser Ile Gly Ile Asp Ala Trp Arg Phe Asp Tyr Val Lys Gly Tyr Ala Pro Trp Val Val Arg Asp Trp  
Leu Asn Trp Trp Gly Gly Trp Ala Val Gly Glu Tyr Trp Asp Thr Asn Val Asp Ala Val Leu Asn Trp  
Ala Tyr Ser Ser Gly Ala Lys Val Phe Asp Phe Ala Leu Tyr Tyr Lys Met Asp Glu Ala Phe Asp Asn  
Asn Asn Ile Pro Ala Leu Val Asp Ala Leu Arg Tyr Gly Gln Thr Val Val Ser Arg Asp Pro Phe Lys  
Ala Val Thr Phe Val Ala Asn His Asp Thr Asp Ile Ile Trp Asn Lys Tyr Pro Ala Tyr Ala Phe Ile  
Leu Thr Tyr Glu Gly Gln Pro Thr Ile Phe Tyr Arg Asp Tyr Glu Glu Trp Leu Asn Lys Asp Lys Leu  
Lys Asn Leu Ile Trp Ile His Asp Asn Leu Ala Gly Gly Ser Thr Asp Ile Val Tyr Tyr Asp Asn Asp  
Glu Leu Ile Phe Val Arg Asn Gly Tyr Gly Ser Lys Pro Gly Leu Ile Thr Tyr Ile Asn Leu Gly Ser Ser  
Lys Ala Gly Arg Trp Val Tyr Val Pro Lys Phe Ala Gly Ser Cys Ile His Glu Tyr Thr Gly Asn Leu  
Gly Gly Trp Val Asp Lys Trp Val Asp Ser Ser Gly Trp Val Tyr Leu Glu Ala Pro Ala His Asp Pro  
Ala Asn Gly Gln Tyr Gly Tyr Ser Val Trp Ser Tyr Cys Gly Val Gly

SEQ ID NO.: 77

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accgactgggcaagcgccgggatttcggcgatatggatccctcccgagcaagggtatgagcggcggtattcgatgggctacgacctt  
acgattattttgacctcgggtgagtactaccagaagggaacgggtgaaacgaggttcggctcaaagcaggagctcataaacatgataaacaccg  
cccacgcctatggcatgaaggtaatagccgatatagtcatcaaccaccgcgccggcggtgacctggagtgaaccccttcgtgaacgactata  
cctggaccgacttctcaaaggtcgcgtcgggtaaatacacggccaactacctcgacttccacccgaacgagctccatgcgggcgattccggaa  
catttggaggctatcccgacatatgccacgacaagagctgggaccagtactggctctgggccagccaggagagctacgcggcctatctcagg  
agcatcggcatcgatgcctggcgcttcgactacgtcaagggttatgctccctgggtcgtcaaggactggctgaactggtggggaggctgggc  
gggtggagagtactgggacaccaacgtcgacgctgttctcaactgggcatactcgagcgggtgccaaggctttgacttcgccctctactacaaga  
tgagcagggccttcgataacaacaacattcccgccctgggtggacgccctcagatacggtcagacagtggtcagccgcgacccgtcaaggct  
gtgacgtttgtagccaaccacgataccgacataatctggaacaagtatccagcctacgcgttcacctcacctacgagggccagccgacaatatt  
ctaccgcgactacgaggagtgggtcaacaaggataagctcaagaacctcatctggatacatgacaacctcgccggaggggagcactgacatcg  
tttactacgacaacgacgagctgatattcgtgaaaacgggtacggaagcaagccgggactgataacatacatcaacctcgctcaagcaaag  
ccggaaggtgggtttacgttccgaagttcgcaggctcgtgcatacacgagtacaccggcaatctcgccggctgggtggacaagtgggtggac  
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Figure 16AA



## SEQ ID NO.: 78

Met Ala Leu Glu Glu Gly Gly Leu Ile Met Gln Ala Phe Tyr Trp Asp Val Pro Met Gly Gly Ile Trp  
Trp Asp Thr Ile Ala Gln Lys Ile Pro Asp Trp Ala Ser Ala Gly Ile Ser Ala Ile Trp Ile Pro Pro Ala  
Ser Lys Gly Met Ser Gly Gly Tyr Ser Met Gly Tyr Asp Pro Tyr Asp Tyr Phe Asp Leu Gly Glu Tyr  
Tyr Gln Lys Gly Thr Val Glu Thr Arg Phe Gly Ser Lys Gln Glu Leu Ile Asn Met Ile Asn Thr Ala  
His Ala Tyr Gly Met Lys Val Ile Ala Asp Ile Val Ile Asn His Arg Ala Gly Gly Asp Leu Glu Trp  
Asn Pro Phe Val Asn Asp Tyr Thr Trp Thr Asp Phe Ser Lys Val Ala Ser Gly Lys Tyr Thr Ala Asn  
Tyr Leu Asp Phe His Pro Asn Glu Leu His Ala Gly Asp Ser Gly Thr Phe Gly Gly Tyr Pro Asp Ile  
Cys His Asp Lys Ser Trp Asp Gln Tyr Trp Leu Trp Ala Ser Gln Glu Ser Tyr Ala Ala Tyr Leu Arg  
Ser Ile Gly Ile Asp Ala Trp Arg Phe Asp Tyr Val Lys Gly Tyr Ala Pro Trp Val Val Lys Asp Trp  
Leu Asn Trp Trp Gly Gly Trp Ala Val Gly Glu Tyr Trp Asp Thr Asn Val Asp Ala Val Leu Asn Trp  
Ala Tyr Ser Ser Gly Ala Lys Val Phe Asp Phe Ala Leu Tyr Tyr Lys Met Asp Glu Ala Phe Asp Asn  
Asn Asn Ile Pro Ala Leu Val Asp Ala Leu Arg Tyr Gly Gln Thr Val Val Ser Arg Asp Pro Phe Lys  
Ala Val Thr Phe Val Ala Asn His Asp Thr Asp Ile Ile Trp Asn Lys Tyr Pro Ala Tyr Ala Phe Ile  
Leu Thr Tyr Glu Gly Gln Pro Thr Ile Phe Tyr Arg Asp Tyr Glu Glu Trp Leu Asn Lys Asp Lys Leu  
Lys Asn Leu Ile Trp Ile His Asp Asn Leu Ala Gly Gly Ser Thr Asp Ile Val Tyr Tyr Asp Asn Asp  
Glu Leu Ile Phe Val Arg Asn Gly Tyr Gly Ser Lys Pro Gly Leu Ile Thr Tyr Ile Asn Leu Ala Ser Ser  
Lys Ala Gly Arg Trp Val Tyr Val Pro Lys Phe Ala Gly Ser Cys Ile His Glu Tyr Thr Gly Asn Leu  
Gly Gly Trp Val Asp Lys Trp Val Asp Ser Ser Gly Trp Val Tyr Leu Glu Ala Pro Ala His Asp Pro  
Ala Asn Gly Gln Tyr Gly Tyr Ser Val Trp Ser Tyr Cys Gly Val Gly

## SEQ ID NO.: 79

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gtggtacgatccggaatccgcaatatggattcccccgcgagcaagggcatgggcggcgctattcgatgggctacgacccctacgactt  
ctttgacctcgggtgagtacgaccagaagggaacggtagagacgcgtttggctccaagcaggagctcgtgaacatgataaacaccgcccacg  
cctacggcatcaaggatcgcagacatagtaatcaaccaccgcgcggaggagaccttgagtgaaccccttcgtcaatgactacacctgga  
cggacttctcgaaggtcgttccggcaagtacacggccaactacctcgacttccacccaacgaggtcaagtctcgcacgaggggcacctttg  
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tctactacgataacgatgaactcatcttcgtaggaacggctacggggacaagccggggcttataacctacatcaacctaggctcgagcaagg  
ccgggaggtgggtctacgttccgaagttcggggagcgtgcatccacgagtacaccggcaacctcgccgggtgggtgggacaaagtgggtgga  
ctcaagcgggigggtgtacctcgaggccctgccacgacccggccaacggctattacggctactccgctcggagctactcgggggtgggt  
ga

## SEQ ID NO.: 80

Met Lys Pro Ala Lys Leu Leu Val Phe Val Leu Val Val Ser Ile Leu Ala Gly Leu Tyr Ala Gln Pro  
Ala Gly Ala Ala Lys Tyr Leu Glu Leu Glu Gly Gly Val Ile Met Gln Ala Phe Tyr Trp Asp Val  
Pro Ser Gly Gly Ile Trp Trp Asp Thr Ile Arg Gln Lys Ile Pro Glu Trp Tyr Asp Ala Gly Ile Ser Ala  
Ile Trp Ile Pro Pro Ala Ser Lys Gly Met Gly Gly Ala Tyr Ser Met Gly Tyr Asp Pro Tyr Asp Phe  
Phe Asp Leu Gly Glu Tyr Asp Gln Lys Gly Thr Val Glu Thr Arg Phe Gly Ser Lys Gln Glu Leu Val  
Asn Met Ile Asn Thr Ala His Ala Tyr Gly Ile Lys Val Ile Ala Asp Ile Val Ile Asn His Arg Ala Gly  
Gly Asp Leu Glu Trp Asn Pro Phe Val Asn Asp Tyr Thr Trp Thr Asp Phe Ser Lys Val Ala Ser Gly  
Lys Tyr Thr Ala Asn Tyr Leu Asp Phe His Pro Asn Glu Val Lys Cys Cys Asp Glu Gly Thr Phe  
Gly Gly Phe Pro Asp Ile Ala His Glu Lys Ser Trp Asp Gln Tyr Trp Leu Trp Ala Ser Asn Glu Ser  
Tyr Ala Ala Tyr Leu Arg Ser Ile Gly Val Asp Ala Trp Arg Phe Asp Tyr Val Lys Gly Tyr Gly Ala

Figure 16BB



Trp Val Val Lys Asp Trp Leu Asp Trp Trp Gly Gly Trp Ala Val Gly Glu Tyr Trp Asp Thr Asn Val  
Asp Ala Leu Leu Asn Trp Ala Tyr Ser Ser Asp Ala Lys Val Phe Asp Phe Pro Leu Tyr Tyr Lys Met  
Asp Ala Ala Phe Asp Asn Lys Asn Ile Pro Ala Leu Val Glu Ala Leu Lys Asn Gly Gly Thr Val Val  
Ser Arg Asp Pro Phe Lys Ala Val Thr Phe Val Ala Asn His Asp Thr Asp Ile Ile Trp Asn Lys Tyr  
Pro Ala Tyr Ala Phe Ile Leu Thr Tyr Glu Gly Gln Pro Thr Ile Phe Tyr Arg Asp Tyr Glu Glu Trp  
Leu Asn Lys Asp Arg Leu Lys Asn Leu Ile Trp Ile His Asp His Leu Ala Gly Gly Ser Thr Asp Ile  
Val Tyr Tyr Asp Asn Asp Glu Leu Ile Phe Val Arg Asn Gly Tyr Gly Asp Lys Pro Gly Leu Ile Thr  
Tyr Ile Asn Leu Gly Ser Ser Lys Ala Gly Arg Trp Val Tyr Val Pro Lys Phe Ala Gly Ala Cys Ile  
His Glu Tyr Thr Gly Asn Leu Gly Gly Trp Val Asp Lys Trp Val Asp Ser Ser Gly Trp Val Tyr Leu  
Glu Ala Pro Ala His Asp Pro Ala Asn Gly Tyr Tyr Gly Tyr Ser Val Trp Ser Tyr Cys Gly Val Gly

SEQ ID NO.: 81

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ggtacgaggcgggaatatccgccatttggattccgccagccagcaaggggatgagcggcggttactcgtatgggtacgatccctacgatttctt  
tgacctcgccgagtagacaaccagaagggaaccatcgaaacgcgcttggctctaacaggagctcatcaatatgataaacaggcccatgccta  
cggcataaaggtagatagcggacatcgataaaccaccgcgcaggcggagacctcgagtgaaccggttcgttggggactacacctggacg  
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gagtactgggacaccaacgttgatgcactcctcaactgggctactcgagcggcgccaaggtcttcgacttcccgtctactacaagatggatg  
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tacgaggagtggctcaacaaggacaggtgaacaacctcatatggatacacgaccacctcgaggtggaagcacgagcatagctactacga  
cagcgacgagatgatcttctgtaggaacggctatggaagcaagcctggccttataacttacatcaacctcggtcgagcaaggttgaaggtg  
ggtttatgtgccgaagttcgggcgcggtgcacccagagtatactggtaacctcgaggctgggttagacaagtacgtctactcaagcggctg  
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SEQ ID NO.: 82

Met Lys Lys Phe Val Ala Leu Phe Ile Thr Met Phe Phe Val Val Ser Met Ala Val Val Ala Gln Pro  
Ala Ser Ala Ala Lys Tyr Ser Glu Leu Glu Glu Gly Gly Val Ile Met Gln Ala Phe Tyr Trp Asp Val  
Pro Gly Gly Gly Ile Trp Trp Asp Thr Ile Arg Ser Lys Ile Pro Glu Trp Tyr Glu Ala Gly Ile Ser Ala  
Ile Trp Ile Pro Pro Ala Ser Lys Gly Met Ser Gly Gly Tyr Ser Met Gly Tyr Asp Pro Tyr Asp Phe  
Phe Asp Leu Gly Glu Tyr Asn Gln Lys Gly Thr Ile Glu Thr Arg Phe Gly Ser Lys Gln Glu Leu Ile  
Asn Met Ile Asn Thr Ala His Ala Tyr Gly Ile Lys Val Ile Ala Asp Ile Val Ile Asn His Arg Ala Gly  
Gly Asp Leu Glu Trp Asn Pro Phe Val Gly Asp Tyr Thr Trp Thr Asp Phe Ser Lys Val Ala Ser Gly  
Lys Tyr Thr Ala Asn Tyr Leu Asp Phe His Pro Asn Glu Val Lys Cys Cys Asp Glu Gly Thr Phe  
Gly Gly Phe Pro Asp Ile Ala His Glu Lys Ser Trp Asp Gln His Trp Leu Trp Ala Ser Asp Glu Ser  
Tyr Ala Ala Tyr Leu Arg Ser Ile Gly Val Asp Ala Trp Arg Phe Asp Tyr Val Lys Gly Tyr Gly Ala  
Trp Val Val Lys Asp Trp Leu Asn Trp Trp Gly Gly Trp Ala Val Gly Glu Tyr Trp Asp Thr Asn Val  
Asp Ala Leu Leu Asn Trp Ala Tyr Ser Ser Gly Ala Lys Val Phe Asp Phe Pro Leu Tyr Tyr Lys Met  
Asp Glu Ala Phe Asp Asn Lys Asn Ile Pro Ala Leu Val Ser Ala Leu Gln Asn Gly Gln Thr Val Val  
Ser Arg Asp Pro Phe Lys Ala Val Thr Phe Val Ala Asn His Asp Thr Asp Ile Ile Trp Asn Lys Tyr  
Leu Ala Tyr Ala Phe Ile Leu Thr Tyr Glu Gly Gln Pro Val Ile Phe Tyr Arg Asp Tyr Glu Glu Trp  
Leu Asn Lys Asp Arg Leu Asn Asn Leu Ile Trp Ile His Asp His Leu Ala Gly Gly Ser Thr Ser Ile  
Val Tyr Tyr Asp Ser Asp Glu Met Ile Phe Val Arg Asn Gly Tyr Gly Ser Lys Pro Gly Leu Ile Thr  
Tyr Ile Asn Leu Gly Ser Ser Lys Val Gly Arg Trp Val Tyr Val Pro Lys Phe Ala Gly Ala Cys Ile  
His Glu Tyr Thr Gly Asn Leu Gly Gly Trp Val Asp Lys Tyr Val Tyr Ser Ser Gly Trp Val Tyr Leu  
Glu Ala Pro Ala Tyr Asp Pro Ala Asn Gly Gln Tyr Gly Tyr Ser Val Trp Ser Tyr Cys Gly Val Gly



Figure 16CC

## SEQ ID NO.: 83

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gatttcttgacctcggcgagtactatcagaaggggacagttgagacgcgcttcggctcaaagggaagaactggtgaacatgataaacaccgca  
cactcctacggcataaagggtgatagcagacatagtcataaaccaccgcgcgggtggagaccttgagtgaacccctcgtgaacgactatacct  
ggacagacttctcaaaagtcgcctccggttaaataatagcgccaactaccttgacttccacccaacgagcttctactgttgatgaaggtaccttg  
gaggataccctgatataatgtcacgacaaaagctgggaccagtactggctctgggcgagcagcgaaagctacgctgcctacctcaggagcata  
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gagtactgggacacgaacgttgatgcactcctcaactgggcatacagcagcgccgaaggtcttgacttccgctctactacaagatggacg  
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## SEQ ID NO.: 84

Met Ala Leu Glu Asp Gly Gly Leu Ile Met Gln Ala Phe Tyr Trp Asp Val Pro Gly Gly Gly Ile Trp  
Trp Asp Thr Ile Ala Gln Lys Ile Pro Glu Trp Ala Ser Ala Gly Ile Ser Ala Ile Trp Ile Pro Pro Ala  
Ser Lys Gly Met Ser Gly Gly Tyr Ser Met Gly Tyr Asp Pro Tyr Asp Phe Phe Asp Leu Gly Glu Tyr  
Tyr Gln Lys Gly Thr Val Glu Thr Arg Phe Gly Ser Lys Glu Glu Leu Val Asn Met Ile Asn Thr Ala  
His Ser Tyr Gly Ile Lys Val Ile Ala Asp Ile Val Ile Asn His Arg Ala Gly Gly Asp Leu Glu Trp Asn  
Pro Phe Val Asn Asp Tyr Thr Trp Thr Asp Phe Ser Lys Val Ala Ser Gly Lys Tyr Thr Ala Asn Tyr  
Leu Asp Phe His Pro Asn Glu Leu His Cys Cys Asp Glu Gly Thr Phe Gly Gly Tyr Pro Asp Ile Cys  
His Asp Lys Ser Trp Asp Gln Tyr Trp Leu Trp Ala Ser Ser Glu Ser Tyr Ala Ala Tyr Leu Arg Ser  
Ile Gly Val Asp Ala Trp Arg Phe Asp Tyr Val Lys Gly Tyr Gly Ala Trp Val Val Asn Asp Trp Leu  
Ser Trp Trp Gly Gly Trp Ala Val Gly Glu Tyr Trp Asp Thr Asn Val Asp Ala Leu Leu Asn Trp Ala  
Tyr Ser Ser Gly Ala Lys Val Phe Asp Phe Pro Leu Tyr Tyr Lys Met Asp Glu Ala Phe Asp Asn Thr  
Asn Ile Pro Ala Leu Val Asp Ala Leu Arg Tyr Gly Gln Thr Val Val Ser Arg Asp Pro Phe Lys Ala  
Val Thr Phe Val Ala Asn His Asp Thr Asp Ile Ile Trp Asn Lys Tyr Pro Ala Tyr Ala Phe Ile Leu  
Thr Tyr Glu Gly Gln Pro Val Ile Phe Tyr Arg Asp Tyr Glu Glu Trp Leu Asn Lys Asp Lys Leu Asn  
Asn Leu Ile Trp Ile His Asp His Leu Ala Gly Gly Ser Thr Asp Ile Val Tyr Tyr Asp Ser Asp Glu  
Leu Ile Phe Val Arg Asn Gly Tyr Gly Thr Lys Pro Gly Leu Ile Thr Tyr Ile Asn Leu Gly Ser Ser  
Lys Val Gly Arg Trp Val Tyr Val Pro Lys Phe Ala Gly Ser Cys Ile His Glu Tyr Thr Gly Asn Leu  
Gly Gly Trp Ile Asp Lys Tyr Val Ser Ser Ser Gly Trp Val Tyr Leu Glu Ala Pro Ala His Asp Pro  
Ala Asn Gly Tyr Tyr Gly Tyr Ser Val Trp Ser Tyr Cys Gly Val Gly

## SEQ ID NO.: 85

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gatttcttgacctcggcgagtactatcagaaggggacagttgagacgcgcttcggctcaaagggaagaactggtgaacatgataaacaccgca  
cactcctacggcataaagggtgatagcggacatagtcataaaccaccgcgcgggtggaggcctcagtggaacccctcgtgaacgactatacc  
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gagtactgggacactaacgttgatgcactcctcaactgggcatacaacagcgccgaaggtcttgacttccgctctactacaagatggacg  
aagccttcgacaataccaacatccccgcttgggttacgccctcaagaatggcgggacagtggtcagccgcgacccattcaaggcggtaacttt  
cgttgccaaccacgatacagataatctggaacaagtatccggcttatgcattcatccttacctatgagggacagcctgttatattctaccgcgac  
tacgaggagtggctcaacaaggataagcttaacaacctcatctggatacacgatcaccttgctggaggaggactactgacattgtttactacgacg  
cgacgagcttatcttgtgagaaacggctatggcaccacacaggactgataacctatatcaacctcggctcaagcaaagctggaaggtgggtc



Figure 16DD

Applicant(s): Walter Callen et al.  
ENZYMES HAVING ALPHA AMYLASE ACTIVITY AND  
METHODS OF USE THEREOF

tacgttccaaagtgcgcgggttcacatccacaggtacaccggcagcctcggcggttgatagacaagtacgtctcctccagcggctgggtct  
accttgaggccccggccacgacccggccaatggccagtatggctactccgtctggagctattgcggggttggtga

SEQ ID NO.: 86

Met Ala Leu Glu Glu Gly Gly Leu Ile Met Gln Ala Phe Tyr Trp Asp Val Pro Gly Gly Gly Ile Trp  
Trp Asp Thr Ile Ala Gln Lys Ile Pro Glu Trp Ala Ser Ala Gly Ile Ser Ala Ile Trp Ile Pro Pro Ala  
Ser Lys Gly Met Ser Gly Gly Tyr Ser Met Gly Tyr Asp Pro Tyr Asp Phe Phe Asp Leu Gly Glu Tyr  
Tyr Gln Lys Gly Thr Val Glu Thr Arg Phe Gly Ser Lys Glu Glu Leu Val Asn Met Ile Asn Thr Ala  
His Ser Tyr Gly Ile Lys Val Ile Ala Asp Ile Val Ile Asn His Arg Ala Gly Gly Gly Leu Glu Trp Asn  
Pro Phe Val Asn Asp Tyr Thr Trp Thr Asp Phe Ser Lys Val Ala Ser Gly Lys Tyr Thr Ala Asn Tyr  
Leu Asp Phe His Pro Asn Glu Leu His Cys Cys Asp Glu Gly Thr Phe Gly Gly Tyr Pro Asp Ile Cys  
His Asp Lys Ser Trp Asp Gln Tyr Trp Leu Trp Ala Ser Ser Glu Ser Tyr Ala Ala Tyr Leu Arg Ser  
Ile Gly Val Asp Ala Trp Cys Phe Asp Tyr Val Lys Gly Tyr Gly Ala Trp Val Val Asn Asp Trp Leu  
Ser Trp Trp Gly Gly Trp Ala Val Gly Glu Tyr Trp Asp Thr Asn Val Asp Ala Leu Leu Asn Trp Ala  
Tyr Asn Ser Gly Ala Lys Val Phe Asp Phe Pro Leu Tyr Tyr Lys Met Asp Glu Ala Phe Asp Asn  
Thr Asn Ile Pro Ala Leu Val Tyr Ala Leu Lys Asn Gly Gly Thr Val Val Ser Arg Asp Pro Phe Lys  
Ala Val Thr Phe Val Ala Asn His Asp Thr Asp Ile Ile Trp Asn Lys Tyr Pro Ala Tyr Ala Phe Ile  
Leu Thr Tyr Glu Gly Gln Pro Val Ile Phe Tyr Arg Asp Tyr Glu Glu Trp Leu Asn Lys Asp Lys Leu  
Asn Asn Leu Ile Trp Ile His Asp His Leu Ala Gly Gly Ser Thr Asp Ile Val Tyr Tyr Asp Ser Asp  
Glu Leu Ile Phe Val Arg Asn Gly Tyr Gly Thr Lys Pro Gly Leu Ile Thr Tyr Ile Asn Leu Gly Ser  
Ser Lys Ala Gly Arg Trp Val Tyr Val Pro Lys Phe Ala Gly Ser Cys Ile His Glu Tyr Thr Gly Ser  
Leu Gly Gly Trp Ile Asp Lys Tyr Val Ser Ser Ser Gly Trp Val Tyr Leu Glu Ala Pro Ala His Asp  
Pro Ala Asn Gly Gln Tyr Gly Tyr Ser Val Trp Ser Tyr Cys Gly Val Gly

SEQ ID NO: 87

atgttctgctcgcgttttgcactgcctcgtgttctgccaacaggacagcccgccaaggctgccgcaccgttaacggcaccatgatgca  
gtatttgaatggtacttgcggatgatggcacgttatggaccaagtggccaatgaagccaacaacttatccagccttggcatcaccgctcttlig  
gctgccgcccgttacaaaggaacaagccgcagcgacgttagggtagggatatacgaacttgatgacctcggcgaaattcaatcaaaaaggga  
ccgtccgcacaaaatacgaacaaaagctcaatatcttcaagccattcaagccgcccacgccgctggaatgcaagtgtacgccgatgtcgtgtt  
cgaccataaaggcggcgctgacggcacggaatgggtggagccgctcgaagtcaatccgtccgaccgcaaccaagaaatctcgggcacat  
caaatccaagcatggacgaaatttgatttccggggcggggcaacacactactccagctttaagtggcgctggtaccattttgacggcggttgattg  
gacgaaagccgaaaattgagccgcatttacaattccgcggcacgcaaaagcgtgggattgggaagtagacacggaaaacggaaactatg  
actactaatgatgacgacattgatattgatcatccgaagtcgtgaccgagctgaaaaactgggggaaatggtatgcaacacaacgaacatt  
gatgggttccggcttgatgccgtaagcataattaagttcagtttttctgattgggtgctgatatgtcgttctcagactggcaagccgctatttaccg  
tcggggaatattggagctatgacatcaacaagttgcacaattacattacgaaaacagacggaacgatgtctttgtttgatgccccgttacacaaca  
aattttataccgcttccaatcagggggcgcatgtgatgcgcaggttaatgaccaatactctcatgaaagatcaaccgacattggccgctacctt  
cggtgataatcatgacaccgaacccggccaagcgtgcagtcattgggtcgacccatggttcaaacggcttgccttatttctaactcggc  
aggaaggatacccgctcgtctttatggtgactattatggcattccacaataacattcctcgtgaaaagcaaaatcgatccgctcctcatcgc  
gcgcagggaattatgcttacggaacgaacatgattatcttgatcactccgacatcatcgggtggacaagggaagggtcactgaaaaccagg  
atccgggctggccgcactgatcaccgatggcgccgggaggaagcaaatggtgtactgttgcaacaacacgctggaagggtgtctatga

SEQ ID NO: 88

Met Phe Leu Leu Ala Phe Leu Leu Thr Ala Ser Leu Phe Cys Pro Thr Gly Gln Pro Ala Lys Ala Ala  
Ala Pro Phe Asn Gly Thr Met Met Gln Tyr Phe Glu Trp Tyr Leu Pro Asp Asp Gly Thr Leu Trp Thr  
Lys Val Ala Asn Glu Ala Asn Asn Leu Ser Ser Ser Leu Gly Ile Thr Ala Leu Trp Leu Pro Pro Ala Tyr  
Lys Gly Thr Ser Arg Ser Asp Val Gly Tyr Gly Val Tyr Asp Leu Tyr Asp Leu Gly Glu Phe Asn Gln  
Lys Gly Thr Val Arg Thr Lys Tyr Gly Thr Lys Ala Gln Tyr Leu Gln Ala Ile Gln Ala Ala His Ala  
Ala Gly Met Gln Val Tyr Ala Asp Val Val Phe Asp His Lys Gly Gly Ala Asp Gly Thr Glu Trp Val  
Asp Ala Val Glu Val Asn Pro Ser Asp Arg Asn Gln Glu Ile Ser Gly Thr Tyr Gln Ile Gln Ala Trp  
Thr Lys Phe Asp Phe Pro Gly Arg Gly Asn Thr Tyr Ser Ser Phe Lys Trp Arg Trp Tyr His Phe Asp



Figure 16EE

Gly Val Asp Trp Asp Glu Ser Arg Lys Leu Ser Arg Ile Tyr Lys Phe Arg Gly Ile Gly Lys Ala Trp  
Asp Trp Glu Val Asp Thr Glu Asn Gly Asn Tyr Asp Tyr Leu Met Tyr Ala Asp Leu Asp Met Asp  
His Pro Glu Val Val Thr Glu Leu Lys Asn Trp Gly Lys Trp Tyr Val Asn Thr Thr Asn Ile Asp Gly  
Phe Arg Leu Asp Ala Val Lys His Ile Lys Phe Ser Phe Phe Pro Asp Trp Leu Ser Tyr Val Arg Ser  
Gln Thr Gly Lys Pro Leu Phe Thr Val Gly Glu Tyr Trp Ser Tyr Asp Ile Asn Lys Leu His Asn Tyr  
Ile Thr Lys Thr Asp Gly Thr Met Ser Leu Phe Asp Ala Pro Leu His Asn Lys Phe Tyr Thr Ala Ser  
Lys Ser Gly Gly Ala Phe Asp Met Arg Thr Leu Met Thr Asn Thr Leu Met Lys Asp Gln Pro Thr  
Leu Ala Val Thr Phe Val Asp Asn His Asp Thr Glu Pro Gly Gln Ala Leu Gln Ser Trp Val Asp Pro  
Trp Phe Lys Pro Leu Ala Tyr Ala Phe Ile Leu Thr Arg Gln Glu Gly Tyr Pro Cys Val Phe Tyr Gly  
Asp Tyr Tyr Gly Ile Pro Gln Tyr Asn Ile Pro Ser Leu Lys Ser Lys Ile Asp Pro Leu Leu Ile Ala Arg  
Arg Asp Tyr Ala Tyr Gly Thr Gln His Asp Tyr Leu Asp His Ser Asp Ile Ile Gly Trp Thr Arg Glu  
Gly Val Thr Glu Lys Pro Gly Ser Gly Leu Ala Ala Leu Ile Thr Asp Gly Pro Gly Gly Ser Lys Trp  
Met Tyr Cys Trp Gln Thr Thr Arg Trp Lys Ser Val Leu

SEQ ID NO: 89

atgaaagaagcgggtgtgtatcaaatctcccgatcgggtctttaatggcaaccctcaaatgataacagcaagcagcaggcacgcggggcgc  
agccgattgagcatcgcatgtggtcggatttggcgataatccgcgcctgaaagggacgagcggctacgatggcgacgggtgaatggtcgaat  
gacttttcggcgagacatcgccggaattgaacaaaagtggattatttcgagtcgcttgagtgagacacgatttacttaaatccgatcgccaatg  
cgccatcgaaaccataaatatgatgcgagcaattacaagaattggatccgatgttcgggtcccggaagaattccaatcgtttgtcaggcggttg  
cgaaccgggggatgcatctcatcttagacggggtgttcaaccacgtatccgacgattcgttactttgaccgctaccaccgctatccgaccgtc  
gggtgcgtatgaatattgggaagcgggttacgattgatgaataaaaggattgagcaggaagaagcgcggaaacaagtgaagagaagttc  
aaacaagaggggacagcgttcagcccgtatgggttcatcttgggtcaatattgaaaacaaaaagtcaatggccattatcaataccaatcatggt  
ggggctatgacagctcggcgaggttaagtgggtgacgggggaaaaagtgccgcatccgagtgaaatgaacaacgatgcgtcgcgaattac  
atttccggtgaatcggttcggcgaaaagctggattgccctcggcgccctcggttggcggttgatgtggccaatgaggtggatccggcgt  
tttggcgagtttcgccaagaattgctcaagggtcgtacggccgcggtccgacgttaaaagagggggagcagccgctcatttaggggaaa  
tttgggatgacgcatcgaaatatttctagggaccagtgatccgtgatgaactaccggttccgcggggcggtgcttacttttgaacacg  
gaaatgcagaagagggcggaacagcgggtgacggccataaggggaagactaccaagtgaaagcgtttatgcgctgatgaactaatcggttcg  
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aaaaagcgggtcaagctggcggtgattttgcagatgggatacccgggagcggcgacgattattacggcgatgaagcgggagtaacaggctc  
aaaagaccagacaaccgccgcacgtatccgtggggcaagaagatcaaaatctgtgtccattatcagaagtggggcacattcggcagc  
accatcaatcgttgttggcccatggcgacatcaagacgggtgtatgcgcaagggtgatgtatcttggccccaatagggcggtgaagcgg  
cgctcattgccatcaaccgcggcaatgaggacaagacgggtggcggtgacgtcgttctgttctccgaacggcaccgtgcttaccgatgagtt  
gcatgatggcggggaagctacgggtcgttggcggaacgttgacgggtcacgattccggccctggatggacggatgatgttgggacgggtgacg  
gcggaaatgccggcagcagtcagcaattgcaggcgagcgcttcggatggctgcgtgacgttaacgtgggaaggaaatgcatcgagatacc  
gaatttacgagtcacgttaaaaggtgccggttatacagtggtgcaagagacggaaacaacttcggccacgatcggttcgttgacgaacggaa  
cagcctattactttccggttgcggcggtcgatgaaaacgggaatgaatcaccgaagggtcgaacgaatcgctcgttctcattaccgcgtgac  
gagcgacaatgtccagttcgtgacaacgttaagcgatccacactggatttgcataagccgcagcaagtggatgtccatgcaacatcgacaat  
gtgacaagcaaaaggagcagctgatgggttgaacgggtgttgcgaagtgaaggcccgatgacgaaacatggaagaatacagagcggctt  
accaaggacaagacggcgacgccaacgtgttcgagctgccttactccgctcggcgagggacgtatacgtatcgttatgcgtgacgacc  
aaccttggcgaggagtgatgtatacagaagagaagcaagtacggttgcggcagacaacagcgaccaaatagcgccagcagacgccatcg  
agctgcggcagcctgcggttgaatcgggacaagtgaatttatcatggacggttgttgggaaaaagatggggatgcttattgttagccatcgag  
cgcaacgggtgatactgtgcatacaaccattcgtacggcgattcattacagactacgatgtcgaaaacggcaccgagtaacgatgttgcac  
gttgcgtgacggcgccggcaatgttgcgtgcaaacacgggtcaaggtgacggcgacattgtgatgtgaaagtgttttaaaagtgcagcgcg  
ccgattacacaccgttggatggcggaattacgattccgaacagctgaacggctggaacacagggcgctgggagatgtcgcgcaacgggtgc  
gggtgacggcgatttggcaatttaccgtcaggtgacggaagggaacgatcactataagtgtgaaaggcggtatcgtgggatcaagagg  
gggtggcgaccatacgcgtgaggacgacaacgatgatgacgtgagctactacggctatgggacgattggcaccgacttgaagtgcggtc  
cacaatgaaggaaacaatacagatgattgtgcaagaccgcatcttgcgctggatgatatgccgggtcgtatcgaaagaggtgcaaaaacaagga  
agtcaagtacgatcaaggcgatgccattaaaaacggtgtttgacgatcaatggcgagcgggtgccgattgatggcggtatggcattctcgt  
acacggttgcggcgccgacccatcaaaaagaagtgttgatccatcgaaccatcgcccgaaagcaaacagccatttcaaacacgacggcg



Figure 16FF

gagcgattgcgaaaaacacaaaagattacgtgctgaatttagaaacgaagcaattcaaaaagcttctcgagagtacttctagagcgcccgcg  
gccccatcgattttccacccgggtgggtaccagga

SEQ ID NO: 90

Met Lys Glu Ala Val Val Tyr Gln Ile Phe Pro Asp Arg Phe Phe Asn Gly Asn Pro Ser Asn Asp Asn  
Ser Lys Gln Gln Ala Arg Gly Ala Gln Pro Ile Glu His Arg Asp Trp Ser Asp Leu Pro Asp Asn Pro  
Arg Leu Lys Gly Thr Ser Gly Tyr Asp Gly Asp Gly Glu Trp Ser Asn Asp Phe Phe Gly Gly Asp Ile  
Ala Gly Ile Glu Gln Lys Leu Asp Tyr Leu Gln Ser Leu Gly Val Asn Thr Ile Tyr Leu Asn Pro Ile  
Ala Asn Ala Pro Ser Asn His Lys Tyr Asp Ala Ser Asn Tyr Lys Glu Leu Asp Pro Met Phe Gly Ser  
Pro Glu Glu Phe Gln Ser Phe Val Gln Ala Leu Ala Asn Arg Gly Met His Leu Ile Leu Asp Gly Val  
Phe Asn His Val Ser Asp Asp Ser Ile Tyr Phe Asp Arg Tyr His Arg Tyr Pro Thr Val Gly Ala Tyr  
Glu Tyr Trp Glu Ala Val Tyr Asp Leu Met Asn Glu Lys Gly Leu Ser Glu Glu Glu Ala Arg Lys Gln  
Val Glu Glu Lys Phe Lys Gln Glu Gly Gln Thr Phe Ser Pro Tyr Gly Phe His Leu Trp Phe Asn Ile  
Glu Asn Lys Lys Val Asn Gly His Tyr Gln Tyr Gln Ser Trp Trp Gly Tyr Asp Ser Leu Pro Glu Phe  
Lys Ser Val Thr Gly Glu Lys Val Pro His Pro Ser Glu Leu Asn Asn Asp Ala Leu Ala Asn Tyr Ile  
Phe Arg Glu Ser Asp Ser Val Ala Lys Ser Trp Ile Ala Leu Gly Ala Ser Gly Trp Arg Leu Asp Val  
Ala Asn Glu Val Asp Pro Ala Phe Trp Arg Glu Phe Arg Gln Glu Leu Leu Gln Gly Ser Tyr Gly Arg  
Gly Pro Thr Leu Lys Glu Gly Glu Gln Pro Leu Ile Leu Gly Glu Ile Trp Asp Asp Ala Ser Lys Tyr  
Phe Leu Gly Asp Gln Tyr Asp Ser Val Met Asn Tyr Arg Phe Arg Gly Ala Val Leu Asp Phe Leu  
Lys Asn Gly Asn Ala Glu Glu Ala Asp Lys Arg Leu Thr Ala Ile Arg Glu Asp Tyr Pro Ser Glu Ala  
Phe Tyr Ala Leu Met Asn Leu Ile Gly Ser His Asp Thr Ala Arg Ala Val Phe Leu Leu Gly Asn Gly  
Thr Asp Ser Ser Glu Arg Ala Glu Leu Asp Pro Asn Tyr Asn Glu Glu Leu Gly Lys Lys Arg Leu  
Lys Leu Ala Val Ile Leu Gln Met Gly Tyr Pro Gly Ala Pro Thr Ile Tyr Tyr Gly Asp Glu Ala Gly  
Val Thr Gly Ser Lys Asp Pro Asp Asn Arg Arg Thr Tyr Pro Trp Gly Lys Glu Asp Gln Asn Leu  
Leu Ser His Tyr Gln Lys Val Gly His Ile Arg Gln His His Gln Ser Leu Leu Ala His Gly Asp Ile  
Lys Thr Val Tyr Ala Gln Gly Asp Val Tyr Val Phe Ala Arg Gln Tyr Gly Arg Glu Ala Ala Leu Ile  
Ala Ile Asn Arg Gly Asn Glu Asp Lys Thr Val Ala Leu Asp Val Ala Ser Leu Leu Pro Asn Gly Thr  
Val Leu Thr Asp Glu Leu His Asp Gly Gly Glu Ala Thr Val Ala Gly Gly Thr Leu Thr Val Thr Ile  
Pro Ala Leu Asp Gly Arg Met Met Phe Gly Thr Val Thr Ala Glu Met Pro Ala Ala Val Ser Asn Leu  
Gln Ala Ser Ala Ser Asp Gly Cys Val Thr Leu Thr Trp Glu Gly Asn Ala Ser Arg Tyr Arg Ile Tyr  
Glu Ser Thr Leu Lys Gly Ala Gly Tyr Thr Met Val Gln Glu Thr Glu Thr Thr Ser Ala Thr Ile Gly  
Ser Leu Thr Asn Gly Thr Ala Tyr Tyr Phe Ala Val Ala Ala Val Asp Glu Asn Gly Asn Glu Ser Pro  
Lys Val Glu Thr Asn Arg Val Val Pro His Tyr Pro Leu Thr Ser Asp Asn Val Gln Phe Val Thr Thr  
Leu Ser Asp Ala Thr Leu Asp Leu Ser Lys Pro Gln Gln Val Asp Val His Val Asn Ile Asp Asn Val  
Thr Ser Lys Gly Ala Ala Asp Gly Leu Gln Ala Val Leu Gln Val Lys Gly Pro His Asp Glu Thr Trp  
Lys Glu Tyr Arg Ala Ala Tyr Gln Gly Gln Asp Gly Asp Ala Asn Val Phe Arg Ala Ala Phe Thr Pro  
Leu Ala Ala Gly Thr Tyr Thr Tyr Arg Tyr Ala Leu Thr Thr Asn Leu Gly Glu Glu Trp Met Tyr Thr  
Glu Glu Lys Gln Val Thr Phe Ala Ala Asp Asn Ser Asp Gln Ile Ala Pro Ala Asp Ala Ile Glu Leu  
Arg Gln Pro Ala Val Glu Ser Gly Gln Val Asn Leu Ser Trp Thr Phe Val Gly Lys Lys Asp Gly Asp  
Ala Tyr Leu Leu Ala Ile Glu Arg Asn Gly Asp Ile Val His Thr Thr Thr Ser Ile Gly Asp Ser Phe Thr  
Asp Tyr Asp Val Glu Asn Gly Thr Glu Tyr Thr Tyr Val Val Lys Leu Tyr Asp Arg Ala Gly Asn  
Val Val Ala Ser Asn Thr Val Lys Val Thr Pro Asp Ile Val Met Val Lys Val Ile Phe Lys Val Arg  
Ala Pro Asp Tyr Thr Pro Leu Asp Ala Arg Ile Thr Ile Pro Asn Ser Leu Asn Gly Trp Asn Thr Gly  
Ala Trp Glu Met Ser Arg Asn Gly Ala Val Thr Pro Asp Trp Gln Phe Thr Val Glu Val Gln Glu Gly  
Glu Thr Ile Thr Tyr Lys Tyr Val Lys Gly Gly Ser Trp Asp Gln Glu Gly Leu Ala Asp His Thr Arg  
Glu Asp Asp Asn Asp Asp Asp Val Ser Tyr Tyr Gly Tyr Gly Thr Ile Gly Thr Asp Leu Lys Val Thr  
Val His Asn Glu Gly Asn Asn Thr Met Ile Val Gln Asp Arg Ile Leu Arg Trp Ile Asp Met Pro Val  
Val Ile Glu Glu Val Gln Lys Gln Gly Ser Gln Val Thr Ile Lys Gly Asn Ala Ile Lys Asn Gly Val  
Leu Thr Ile Asn Gly Glu Arg Val Pro Ile Asp Gly Arg Met Ala Phe Ser Tyr Thr Phe Ala Pro Ala  
Ser His Gln Lys Glu Val Leu Ile His Ile Glu Pro Ser Ala Glu Ser Lys Thr Ala Ile Phe Asn Asn Asp



Figure 16GG

Gly Gly Ala Ile Ala Lys Asn Thr Lys Asp Tyr Val Leu Asn Leu Glu Thr Lys Gln Phe Lys Lys Leu  
Leu Glu Ser Thr Ser Arg Ala Ala Ala Gly Pro Ser Ile Phe His Pro Gly Gly Val Pro Gly

SEQ ID NO: 91

gtgctaacgtttaccgcgcatcattcgaaaaggatggatgttcctgctcgcgttttgcactgcctcgtgttctgcccacaggacagcccgcc  
aggtgccgcaccgtttaacggcaccatgatgcagttttgaatggacttgcggatgatggcacgttatggacaaagtggccaatgaagc  
caacaactatccagccttggcatcaccgctcttggctgccgccgcttataaaggaacaagccgcagcgacgtaggttacggagtatacga  
cttgatgacctcggcgaattcaatcaaaaagggaccgtccgcacaaaatacggaaacaaaagctcaatatcttcaagccattcaagccgccac  
gccgctggaatgcaagtgtacgccgatgtcgtgttcgaccataaaggcggcgccgacggcacggaatgggtggacgccgtcgaagtcaatc  
cgccgaccgcaaccaagaaatctcgggcacctatcaatccaagcatggacgaaatttgatttccggggcggggaacacctactccagctt  
taagtggcgctgggtaccattttgacggcgttgattgggacgaaagccgaaaattgagccgcattacaaattccggcgcatcggaagcgtgg  
gattgggaagtagacacggaaacggaaactatgactacttaattgatgccgacttgacatggaccatctgaagtgggttacggaactgaaa  
actggggcaaatggatgtcaacacaacgaacattgatgggttcgggttgatgccgtaagcataattaagttcagtttttctgattggtgtcgt  
atgtgcgttctcagactggcaagccgctattaccgctcgggaatattggagctatgacatcaacaagttgcacaattacattacgaaacaaacg  
gaacgatgtctttgttgatccccgttacacaacaaatttataccgcttccaaatcagggggcgcatgtgatgcgcacgttaataaccaatact  
ctcatgaaagatcaaccgacattggccgtcaccttcttgataatcatgacaccgaaccggccaagcgtgcagtcattgggtcgaccatggt  
tcaaaccgttgcttacgctttattctaactcggcaggaaggataaccgtgcgtctttatggtgactattatggcatccacataataacattcctt  
cgtgaaagcaaaatcgatccgctcctcatcgcgcgagggtattgcttacggaacgcaacatgattatctgatcactccgacatcatcggt  
tgacaagggaaggcgtcactgaaaaaccaggatccggactggccgactgatcaccgatggggccgggaggaagcaaatggatgtacgtt  
ggcaacaacacgccggaaggtgtctatgacctaccggcaaccggagtgacaccgtcaccatcaacagtgatggatggggagaattcaa  
agtcaatggcgggttcggttcggttgggttcctagaaaaacgaccgtctctaccatcgcttggccgatcacaacccgaccgtggactggtgaatt  
cgccgttgaccgaaccacgggttggtggcatggccttga

SEQ ID NO: 92

Val Leu Thr Phe His Arg Ile Ile Arg Lys Gly Trp Met Phe Leu Leu Ala Phe Leu Leu Thr Ala Ser  
Leu Phe Cys Pro Thr Gly Gln Pro Ala Lys Ala Ala Ala Pro Phe Asn Gly Thr Met Met Gln Tyr Phe  
Glu Trp Tyr Leu Pro Asp Asp Gly Thr Leu Trp Thr Lys Val Ala Asn Glu Ala Asn Asn Leu Ser Ser  
Leu Gly Ile Thr Ala Leu Trp Leu Pro Pro Ala Tyr Lys Gly Thr Ser Arg Ser Asp Val Gly Tyr Gly  
Val Tyr Asp Leu Tyr Asp Leu Gly Glu Phe Asn Gln Lys Gly Thr Val Arg Thr Lys Tyr Gly Thr  
Lys Ala Gln Tyr Leu Gln Ala Ile Gln Ala Ala His Ala Ala Gly Met Gln Val Tyr Ala Asp Val Val  
Phe Asp His Lys Gly Gly Ala Asp Gly Thr Glu Trp Val Asp Ala Val Glu Val Asn Pro Ser Asp Arg  
Asn Gln Glu Ile Ser Gly Thr Tyr Gln Ile Gln Ala Trp Thr Lys Phe Asp Phe Pro Gly Arg Gly Asn  
Thr Tyr Ser Ser Phe Lys Trp Arg Trp Tyr His Phe Asp Gly Val Asp Trp Asp Glu Ser Arg Lys Leu  
Ser Arg Ile Tyr Lys Phe Arg Gly Ile Gly Lys Ala Trp Asp Trp Glu Val Asp Thr Glu Asn Gly Asn  
Tyr Asp Tyr Leu Met Tyr Ala Asp Leu Asp Met Asp His Pro Glu Val Val Thr Glu Leu Lys Asn  
Trp Gly Lys Trp Tyr Val Asn Thr Thr Asn Ile Asp Gly Phe Arg Leu Asp Ala Val Lys His Ile Lys  
Phe Ser Phe Phe Pro Asp Trp Leu Ser Tyr Val Arg Ser Gln Thr Gly Lys Pro Leu Phe Thr Val Gly  
Glu Tyr Trp Ser Tyr Asp Ile Asn Lys Leu His Asn Tyr Ile Thr Lys Thr Asn Gly Thr Met Ser Leu  
Phe Asp Ala Pro Leu His Asn Lys Phe Tyr Thr Ala Ser Lys Ser Gly Gly Ala Phe Asp Met Arg Thr  
Leu Met Thr Asn Thr Leu Met Lys Asp Gln Pro Thr Leu Ala Val Thr Phe Val Asp Asn His Asp  
Thr Glu Pro Gly Gln Ala Leu Gln Ser Trp Val Asp Pro Trp Phe Lys Pro Leu Ala Tyr Ala Phe Ile  
Leu Thr Arg Gln Glu Gly Tyr Pro Cys Val Phe Tyr Gly Asp Tyr Tyr Gly Ile Pro Gln Tyr Asn Ile  
Pro Ser Leu Lys Ser Lys Ile Asp Pro Leu Leu Ile Ala Arg Arg Asp Tyr Ala Tyr Gly Thr Gln His  
Asp Tyr Leu Asp His Ser Asp Ile Ile Gly Trp Thr Arg Glu Gly Val Thr Glu Lys Pro Gly Ser Gly  
Leu Ala Ala Leu Ile Thr Asp Gly Pro Gly Gly Ser Lys Trp Met Tyr Val Gly Lys Gln His Ala Gly  
Lys Val Phe Tyr Asp Leu Thr Gly Asn Arg Ser Asp Thr Val Thr Ile Asn Ser Asp Gly Trp Gly Glu  
Phe Lys Val Asn Gly Gly Ser Val Ser Val Trp Val Pro Arg Lys Thr Thr Val Ser Thr Ile Ala Trp  
Pro Ile Thr Thr Arg Pro Trp Thr Gly Glu Phe Val Arg Trp Thr Glu Pro Arg Leu Val Ala Trp Pro

Figure 16HH



SEQ ID NO: 93

atgaaatcggttgcatcgcctatcctttttatgcaaacgatttcacagtgaaagggaaggaggaggagaaaaatggggaagaatatgagaaga  
agattcacgtattttcaatctcttattgttcgttcagctgttttcatttagtgaaccgctagcgccaatggaacggtagacagtagtctgtggttaa  
tggaacgaagtcacgtttctatatggaggaacaggaaacgagcagctgtgttactggcaggctccttaattgattggcagaaagatggtgaca  
agaagattgcactaacaataaaggcgacaataacgtctgtgtgtcagcgaacacttcaagatgggacatatagctataagttgtgttagatggc  
aatgggtggcggatccgctaaccgaatcaagtagacgacgggtacggcgccgtaatagtgtcgttgtgtcgggacacgggtgcaacaag  
aacggacagtgacgcttgttgtaactacaagacgaattaggtcatagcagcgaatgggatccgaaagcgacagctacagtgatgaaaaagg  
aagggaacgggttatatacgtttacaggtacacttccagccggaacgtacgagtataaattgcgattaatggcagctgggacgaaaactatggt  
gtcggcgccgcatggcggaatattaagctgctattaatgaacaaacaacgggttaccattttattacaacgacagaacgcagtgatggcg  
attcgacttggtatgcaccaattctaaaagaaaagcagccgctgtgtggaacgattttaccagctattggtatgaaacagacgtgaacgggt  
ggacgccgcaaacatcaacggcggtgtgtgtcagatgatgatttgcatttatacgtttaaggcgctgtgtccaaaaggacatatgaatataa  
agtagttcttgggaatgattggacatatgaaaattatccacaagataatgccaaataaattgtgtgaagaacgacaattaccttttcttaacgc  
gaaaacgaaagtagtgataccgattacaatccaagcggttcggatggtatcgtccaaaagaccggttgaagcataatacgtgggattcgtgtga  
tcgccaaccggttgggtgcggtgaaagctgggacagaagtgacccttcgtttatcagcgaaaaaagggtgattgacaaaagcggtatgatataa  
aaaatacgaacccggcagcgaaactataatcgtatgaaaaagccggtgttcttggcgagaagaatattgggaagcgacattcacaccgg  
atgtgaaaggagtatacgggtataaattattgcggtagatgctggaacgaaagcagaatacggggaagatacacaagaagggcagtgggga  
aaagcagtagataaaaaatgcagagctgttccaattaacgggtgtacgacctacccaacaccggattggatgaaagaagcagttgtatatca  
aatttccctgatccaaag

SEQ ID NO: 94

Met Lys Ser Phe Ala Phe Met Pro Ile Leu Phe Tyr Ala Asn Asp Phe Ile Ser Glu Arg Glu Gly Gly  
Gly Lys Met Gly Lys Asn Met Arg Arg Arg Phe Thr Tyr Phe Ser Ile Phe Leu Leu Phe Val Gln Leu  
Phe Ser Phe Ser Ala Thr Ala Ser Ala Asn Gly Thr Val Asn Ser Ser Pro Val Val Asn Gly Asn Glu  
Val Thr Phe Leu Tyr Gly Gly Thr Gly Asn Glu Gln Ser Val Leu Leu Ala Gly Ser Phe Asn Asp Trp  
Gln Lys Asp Gly Asp Lys Lys Ile Ala Leu Thr Lys Gly Asp Asn Asn Val Trp Ser Val Thr Gln Thr  
Leu Gln Asp Gly Thr Tyr Thr Tyr Lys Phe Val Val Asp Gly Gln Trp Val Ala Asp Pro Leu Asn Pro  
Asn Gln Val Asp Asp Gly Tyr Gly Gly Arg Asn Ser Val Val Val Gly Thr Pro Val Gln Gln Glu  
Arg Thr Val Thr Leu Val Gly Asn Leu Gln Asp Glu Leu Gly His Thr Ser Glu Trp Asp Pro Lys Ala  
Thr Ala Thr Val Met Lys Lys Glu Gly Asn Gly Leu Tyr Thr Phe Thr Gly Thr Leu Pro Ala Gly Thr  
Tyr Glu Tyr Lys Ile Ala Ile Asn Gly Ser Trp Asp Glu Asn Tyr Gly Val Gly Gly Arg Asp Gly Gly  
Asn Ile Lys Leu Leu Leu Asn Glu Gln Thr Thr Val Thr Phe Tyr Tyr Asn Asp Arg Thr His Ala Ile  
Ala Asp Ser Thr Trp Tyr Ala Pro Ile Leu Lys Glu Lys Gln Pro Arg Leu Val Gly Thr Ile Leu Pro  
Ala Ile Gly Tyr Glu Thr Asp Val Asn Gly Trp Thr Pro Gln Thr Ser Thr Ala Leu Leu Ser Asp Asp  
Asp Phe Asp Ser Ile Tyr Thr Phe Lys Ala Arg Val Pro Lys Gly Thr Tyr Glu Tyr Lys Val Val Leu  
Gly Asn Asp Trp Thr Tyr Glu Asn Tyr Pro Gln Asp Asn Ala Lys Leu Asn Val Leu Glu Glu Thr  
Thr Ile Thr Phe Phe Phe Asn Ala Lys Thr Lys Val Val Tyr Thr Asp Tyr Asn Pro Ser Gly Ser Asp  
Gly Ile Val Gln Lys Asp Arg Leu Lys His Asn Thr Trp Asp Ser Leu Tyr Arg Gln Pro Phe Gly Ala  
Val Lys Ala Gly Thr Glu Val Thr Leu Arg Leu Ser Ala Lys Lys Gly Asp Leu Thr Lys Ala Asp Val  
Tyr Val Lys Asn Thr Thr Thr Gly Thr Ala Lys Leu Tyr Ser Met Lys Lys Ala Gly Val Leu Gly Glu  
Glu Glu Tyr Trp Glu Ala Thr Phe Thr Pro Asp Val Lys Gly Val Tyr Gly Tyr Lys Phe Ile Ala Val  
Asp Ala Gly Thr Lys Ala Glu Tyr Gly Glu Asp Thr Gln Glu Gly Gln Trp Gly Lys Ala Val Asp Lys  
Asn Ala Glu Leu Phe Gln Leu Thr Val Tyr Asp Pro Ser Tyr Gln Thr Pro Asp Trp Met Lys Glu Ala  
Val Val Tyr Gln Ile Phe Pro Asp Pro Lys

SEQ ID NO: 95

atgtatacactattcatccgttcataattttgatactgatggtgatggtgtaggagactttagtgagttgctgaaaaaggtagattatctaaaatctcttg  
gagtatagatacagctcgtgttttaccatttaataaaaagtaaatcttatcatggatatgatgttgaaagattactatgatgtagaaccagattatggaacact  
acaagatcttgataatatgataaaagttcataatgaaaatggaataaaggtagtaatggatcttgttgtaatcatagctcggatacacatccatggtt  
tcttgatgcagttgaaaatactactaattctccatattggaactattacattatgagcttgatgagcctcaaaaataagaatcattggcattataagggt  
aattcaaaaggacaaactgtgtgtattttggattgtttgattcatcaatgccggaccttaattacgacaaccctaaagtaatggatgaagtga

Figure 16II



aataatagattttgggcagatatgggagtagatggatttagattagatgcagcaaacattattatggatttgactggagcgatggaattgaacag  
tcagcaagcgttgcaaaagagatagaagactatataaaagataaactaggggaaaatgcaatagttgtgagtgagggttacgatggagattcaa  
atgttcttttaaaattgtcctcaatgcctgtgttaatttagtttatgtacaatttgagaggaaaatttgaaggagagataacttaatttcagactctatt  
agttgggttgattcctcgtgtataatttaaatgttttcatttccatttattgatatcatgacttgacagattatttctgagcttgtagatagaaatc  
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gacttaggggatggaagtggcattcagaaccatgggatatacctgtgcgtgagccaatgcaatggtataaggatcaaaaagggaacgggtcaaa  
cttattggacaaaagagttttacgaaggtattactgaaggaagtgtctaatgaagatggagcaataacgatgatccagatgatggagtatctgtag  
aagaacaagaaaatggatattctattttaaacttttttaagaatttatcaacttcgaaaagattatccggcacttgcttttggaagtactacgattga  
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gtccagaagggtataaatgggtgtggtatgcatttttgatggtgacaactatgaatttgagcaaaagatgaaatgattttacagaatacaagttg  
gacgataaatccaaggcaatttatatttgaagtaa

## SEQ ID NO: 96

Met Tyr Thr Leu Phe Ile Arg Ser Tyr Phe Asp Thr Asp Gly Asp Gly Val Gly Asp Phe Ser Gly Val  
Ala Glu Lys Val Asp Tyr Leu Lys Ser Leu Gly Val Asp Thr Val Trp Phe Leu Pro Phe Asn Lys Ser  
Lys Ser Tyr His Gly Tyr Asp Val Glu Asp Tyr Tyr Asp Val Glu Pro Asp Tyr Gly Thr Leu Gln Asp  
Leu Asp Asn Met Ile Lys Val Leu Asn Glu Asn Gly Ile Lys Val Val Met Asp Leu Val Val Asn His  
Thr Ser Asp Thr His Pro Trp Phe Leu Asp Ala Val Glu Asn Thr Thr Asn Ser Pro Tyr Trp Asn Tyr  
Tyr Ile Met Ser Leu Asp Glu Pro Gln Asn Lys Asn His Trp His Tyr Lys Val Asn Ser Lys Gly Gln  
Thr Val Trp Tyr Phe Gly Leu Phe Asp Ser Ser Met Pro Asp Leu Asn Tyr Asp Asn Pro Lys Val Met  
Asp Glu Val Lys Lys Ile Ile Asp Phe Trp Ala Asp Met Gly Val Asp Gly Phe Arg Leu Asp Ala Ala  
Lys His Tyr Tyr Gly Phe Asp Trp Ser Asp Gly Ile Glu Gln Ser Ala Ser Val Ala Lys Glu Ile Glu  
Asp Tyr Ile Lys Asp Lys Leu Gly Glu Asn Ala Ile Val Val Ser Glu Val Tyr Asp Gly Asp Ser Asn  
Val Leu Leu Lys Phe Ala Pro Met Pro Val Phe Asn Phe Ser Phe Met Tyr Asn Leu Arg Gly Asn  
Phe Glu Gly Arg Asp Asn Leu Ile Ser Asp Ser Ile Ser Trp Val Asp Ser Ser Leu Tyr Asn Leu Asn  
Val Phe His Phe Pro Phe Ile Asp Ser His Asp Leu Asp Arg Phe Ile Ser Glu Leu Val Asp Ser Lys  
Tyr Gln Gly Asp Val Ile Ser Ala Thr Lys Gln Tyr Leu Leu Val Asn Ala Leu Leu Leu Ser Leu Thr  
Gly Met Pro Thr Ile Tyr Tyr Gly Asp Glu Ile Gly Leu Arg Gly Trp Lys Trp His Ser Glu Pro Trp  
Asp Ile Pro Val Arg Glu Pro Met Gln Trp Tyr Lys Asp Gln Lys Gly Asn Gly Gln Thr Tyr Trp Thr  
Lys Glu Phe Tyr Glu Gly Ile Thr Glu Gly Ser Ala Asn Glu Asp Gly Ala Ile Tyr Asp Asp Pro Asp  
Asp Gly Val Ser Val Glu Glu Gln Glu Asn Gly Tyr Ser Ile Leu Asn Phe Phe Lys Glu Phe Ile Asn  
Leu Arg Lys Asp Tyr Pro Ala Leu Ala Phe Gly Ser Thr Thr Ile Glu Arg Asp Trp Lys Asn Leu Tyr  
Val Leu Lys Lys Ser Tyr Asn Phe Gln Asp Val Leu Val Leu Ile Asn Leu Asp Pro Thr Tyr Ser Asn  
Thr Tyr Glu Val Pro Glu Gly Tyr Lys Trp Val Trp Tyr Ala Phe Phe Asp Gly Asp Asn Tyr Glu Phe  
Gly Ala Lys Asp Glu Met Ile Leu Gln Asn Thr Ser Trp Thr Ile Asn Pro Arg Gln Ile Tyr Ile Phe Val  
Lys

## SEQ ID NO: 97

atgaggaagaagatgtcgcattcaagattacttttctttgatcttagcactttttatttcttccggttgatttcagaagttaaagcgaaagccag  
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tttattgattatcttagtaaagtgtattactgttaaggatgtaaatgatcagattgtatttactaaggaaacaacgaacaaacaaatatttttgaa  
attgaacttctcctggaactatatacatttgaggtaaaaggatatgaggaagatttagttatatttcaggggaaaaagtaatcagatcatagatgag  
aaaaataatattgtaattgtcgaactttttgttaagtgaatagtttaggacaataatgaagttgacgatattattataaaaattatgatattacatcg  
caacgttgatcttcaaaaaagatacagcacaagaagattatgaagaggtacctgtaacacttacaggtactccactttaattaagaattatat  
cctggtatgtggactgtaaaaattgaagttgatcttaaatcaaggatgcagatgttaccagaaaaagttcatcttgaaaaatgaatttagcataga  
agtgtccagcaaaagacaaaaagtttaacatttaattgtagtctttgatacagaggttaattgaaccgaaattagtagttgtattccgcaaattgagtt  
gctttttgtggtcctgtacaaatttaagtgagagataaatgaattagaagggaatctttcaatgaattgggactattcagatccaaatgcagaat  
tttatgtgtataaagaattagaggaacaaggagaattttgtatgaattgttgaaaaacacgcgagaaaagttatacaatagaaaattttaccaag  
caagaattcgataaatttagtggaatcgcttaattgtttatgccaacggtaagagagtgattagttgttcaaaaaaagaaaattataaacttata  
gatttagaaagtgttgacagtataagtgtacttataacgttgatacgaatgagcttaagttgattggaattataccaattcaagtgttactttgaag



Figure 16JJ

ttttgaaaaaagggtataaatagcaatgaatacgaataatttctcaactaacacaaaattcttttcaacagaattcacaggcaggcaattttgggac  
ttgagaaaattgcgattagagtagtgctaatggatttgaaagtaagattaatgagatttcaagagatgataaactataacatcattgaatttctct  
tacatcgctactatgtatacactattcatccgttcatttttgatactgatggtaggtgtaggagacttttagtgagtgctgaaaaggtagattac  
taaaatctcttgagtagatagacgtctggttttaccatttaataaaagtaaatcttatcatggatatgatgtgaagattactatgatgtagaaccagat  
tatggaactacacagatcttgataatgataaaagtctaaatgaaaatggaataaaggtagtaattggatcttggtgtaatacatacgtcggatc  
acatccatgggttcttgatgcagttgaaaatactactaatttccatattggaactattacattatgagcttgatgagcctcaaaaataagaatcattgg  
cattataaggtaattcaaaaggacaaactgtgtggtattttggattgttgattcatcaatgccggacctaattacgacaacctaaagtaattgat  
gaagtgaaaaaataatagatttttgggcagatatgggagtagatggatttagattagatgcagcaaacattattatggatttgactggagcgatg  
gaattgaacagtcagcaagcgttgcaaaagagatagaagactatataaaagataaactaggggaaaatgcaatagtgtgagtgaggttacga  
tgagattcaaatgttcttttaaaattgtctcaatgcctgtgttaattttgattttgtacaatttgagaggaaattttgaaggagagataactaatt  
tcagactctatttagttgggtgattcctcgtgtataaattaaatgttttccattttccatttattgatagtcatgatcttgacagattttctgagctttag  
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tgatgaaataggacttaggggatggaagtggcattcagaacctgggatatacctgtgcgtgagccaatgcaatggtataaggatcaaaaagg  
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gagtatctgtagaagaacaagaaaatggatattctattttaaacttttttaagaatttatcaacttacgaaaagattatccggcactgtcttgggaagt  
actacgattgagagagattggaaaaacttgatgtttgaaaaagtcgtataactccaggatgttctgtattaattaaccttgatccaacgtattcaa  
atacatcgaagttccagaagggtataaatgggtgtgtatgcatttttgatggtgacaactatgaatttgagcaaaagatgaaatgattttacag  
aatacaagttggacgataaatccaaggcaatttatattgttaaagtaa

SEQ ID NO: 98

Met Arg Lys Lys Met Ser His Ser Arg Phe Thr Phe Leu Leu Ile Leu Ala Leu Phe Ile Phe Phe Ser  
Gly Cys Ile Ser Glu Val Lys Ser Glu Ser Gln Leu Leu Asn Ser Lys Gln Lys Val Leu Val Lys Val  
Asn Val Asn Thr Pro Phe Ile Glu Asn Ala Thr Thr Asn Thr Trp Ser Val Ser Lys Glu Ser Phe Ile  
Asp Tyr Leu Ser Lys Val Ile Ile Thr Val Lys Asp Val Asn Asp Gln Ile Val Phe Thr Lys Glu Thr  
Thr Asn Lys Thr Asn Ile Tyr Phe Glu Ile Glu Leu Leu Pro Gly Thr Tyr Thr Phe Glu Val Lys Gly  
Tyr Glu Glu Asp Leu Val Ile Phe Ser Gly Glu Lys Val Asn Gln Ile Ile Asp Glu Lys Asn Asn Ile  
Val Asn Val Glu Thr Phe Phe Val Asn Gly Ile Val Arg Thr Ile Ile Glu Val Asp Asp Ile Ile Tyr Lys  
Asn Tyr Asp Ile Thr Ser Ala Thr Leu Ile Phe Lys Lys Asp Thr Ala Gln Glu Asp Tyr Glu Glu Val  
Pro Val Thr Leu Thr Gly Thr Ser Thr Leu Ile Asn Lys Glu Leu Tyr Pro Gly Met Trp Thr Val Lys  
Phe Glu Val Asp Leu Lys Ser Lys Asp Ala Ser Met Leu Pro Glu Lys Val His Leu Glu Asn Glu Phe  
Ser Ile Glu Val Leu Pro Ala Lys Thr Lys Ser Leu Thr Phe Asn Val Val Phe Asp Thr Glu Val Asn  
Glu Pro Lys Leu Val Val Val Phe Pro Gln Ile Glu Leu Pro Phe Val Asp Pro Val Thr Asn Leu Ser  
Gly Glu Ile Asn Glu Leu Glu Gly Asn Leu Ser Met Asn Trp Asp Tyr Ser Asp Pro Asn Ala Glu Phe  
Tyr Val Tyr Lys Glu Leu Glu Glu Gln Gly Glu Tyr Leu Tyr Glu Phe Val Gly Lys Thr Arg Glu Lys  
Ser Tyr Thr Ile Glu Asn Phe Thr Lys Gln Glu Phe Asp Lys Phe Ser Gly Ile Ala Ile Asn Val Tyr  
Ala Asn Gly Lys Glu Ser Gly Leu Val Val Leu Lys Lys Glu Asn Ile Lys Leu Ile Asp Leu Glu Ser  
Val Asp Ser Ile Ser Ala Thr Tyr Asn Val Asp Thr Asn Glu Leu Lys Leu Asp Trp Asn Tyr Thr Asn  
Ser Ser Val Thr Phe Glu Val Leu Lys Lys Gly Ile Asn Ser Asn Glu Tyr Glu Ile Ile Ser Gln Leu Thr  
Gln Asn Ser Phe Ser Thr Glu Phe Thr Gly Arg Gln Phe Trp Asp Leu Glu Lys Ile Ala Ile Arg Val  
Val Ala Asn Gly Phe Glu Ser Lys Ile Asn Glu Ile Ser Arg Asp Asp Ile Thr Ile Thr Ser Leu Asn Leu  
Pro Leu Thr Ser Ser Thr Met Tyr Thr Leu Phe Ile Arg Ser Tyr Phe Asp Thr Asp Gly Asp Gly Val  
Gly Asp Phe Ser Gly Val Ala Glu Lys Val Asp Tyr Leu Lys Ser Leu Gly Val Asp Thr Val Trp Phe  
Leu Pro Phe Asn Lys Ser Lys Ser Tyr His Gly Tyr Asp Val Glu Asp Tyr Tyr Asp Val Glu Pro Asp  
Tyr Gly Thr Leu Gln Asp Leu Asp Asn Met Ile Lys Val Leu Asn Glu Asn Gly Ile Lys Val Val Met  
Asp Leu Val Val Asn His Thr Ser Asp Thr His Pro Trp Phe Leu Asp Ala Val Glu Asn Thr Thr Asn  
Ser Pro Tyr Trp Asn Tyr Tyr Ile Met Ser Leu Asp Glu Pro Gln Asn Lys Asn His Trp His Tyr Lys  
Val Asn Ser Lys Gly Gln Thr Val Trp Tyr Phe Gly Leu Phe Asp Ser Ser Met Pro Asp Leu Asn Tyr  
Asp Asn Pro Lys Val Met Asp Glu Val Lys Lys Ile Ile Asp Phe Trp Ala Asp Met Gly Val Asp Gly  
Phe Arg Leu Asp Ala Ala Lys His Tyr Tyr Gly Phe Asp Trp Ser Asp Gly Ile Glu Gln Ser Ala Ser  
Val Ala Lys Glu Ile Glu Asp Tyr Ile Lys Asp Lys Leu Gly Glu Asn Ala Ile Val Val Ser Glu Val

Figure 16KK



Applicant(s): Walter Callen et al.  
ENZYMES HAVING ALPHA AMYLASE ACTIVITY AND  
METHODS OF USE THEREOF

Tyr Asp Gly Asp Ser Asn Val Leu Leu Lys Phe Ala Pro Met Pro Val Phe Asn Phe Ser Phe Met Tyr  
Asn Leu Arg Gly Asn Phe Glu Gly Arg Asp Asn Leu Ile Ser Asp Ser Ile Ser Trp Val Asp Ser Ser  
Leu Tyr Asn Leu Asn Val Phe His Phe Pro Phe Ile Asp Ser His Asp Leu Asp Arg Phe Ile Ser Glu  
Leu Val Asp Ser Lys Tyr Gln Gly Asp Val Ile Ser Ala Thr Lys Gln Tyr Leu Leu Val Asn Ala Leu  
Leu Leu Ser Leu Thr Gly Met Pro Thr Ile Tyr Tyr Gly Asp Glu Ile Gly Leu Arg Gly Trp Lys Trp  
His Ser Glu Pro Trp Asp Ile Pro Val Arg Glu Pro Met Gln Trp Tyr Lys Asp Gln Lys Gly Asn Gly  
Gln Thr Tyr Trp Thr Lys Glu Phe Tyr Glu Gly Ile Thr Glu Gly Ser Ala Asn Glu Asp Gly Ala Ile  
Tyr Asp Asp Pro Asp Asp Gly Val Ser Val Glu Glu Gln Glu Asn Gly Tyr Ser Ile Leu Asn Phe Phe  
Lys Glu Phe Ile Asn Leu Arg Lys Asp Tyr Pro Ala Leu Ala Phe Gly Ser Thr Thr Ile Glu Arg Asp  
Trp Lys Asn Leu Tyr Val Leu Lys Lys Ser Tyr Asn Phe Gln Asp Val Leu Val Leu Ile Asn Leu Asp  
Pro Thr Tyr Ser Asn Thr Tyr Glu Val Pro Glu Gly Tyr Lys Trp Val Trp Tyr Ala Phe Phe Asp Gly  
Asp Asn Tyr Glu Phe Gly Ala Lys Asp Glu Met Ile Leu Gln Asn Thr Ser Trp Thr Ile Asn Pro Arg  
Gln Ile Tyr Ile Phe Val Lys

## SEQ ID NO: 99

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gaacatacgcacaacttgaaaatgataaagacactcaatcagaacggaattcgtgttgatggacttggtgtgaaccacactccgatacac  
actcgtggttcttggtgcccgttgagaacacacgaattcgaatatggagctactacataatgacacttgaaaatagagacggttggaatcact  
ggcattggaagataaactcaaaagggcaaaaagtgtactactcggactgttgactcatcaatgcccgatttgaaattcgacaatccacaagtgtat  
gaacgaaatcaagagaataatcgatttctggataacagttggtgtggtggttcagactgatgcacaaagcactacaaggtggtggattggg  
acgacggcatttcaggttcagcagcaatcgcgagggaaatagaagtacatcaggagcaagttaggaacgatgcgatagtgtcggggaa  
gtgtacgatggaatccatcggttcttcacaatttgcaccgatccggcgttcaacttcacattcatgtatggaataacaggcaacctatgagggg  
aaagataacctgctgggagaaacaatttcatgggttaattggagcaggttattatctcaacgtaaaacatttccggtcatagacaatcacgattga  
acagatggatcgcgatactatcgacaaaagtatagtggaacacacaagttgtacgaagcagtatatttaacaaatgcgctctgttcttctta  
aacggtatgcctgttattattatgggaatgaaataggcctgagaggatggaatggggacaagaccggtggattgcccgtgagagagccga  
tgcagtgggtacgcaagtcaaaaggagctgggcagacatggtggacaaagcctgtctaccagcaaaaggaatcacatttggaatgcaaac  
gtcgtatggtgcgatgtacgatgatccaaatgatggggttcagtagaagagcagatgaatggttacacgataaataacttcttaacaattcataa  
ccctgaggaagacatatcgggtctatcgaaagggttcgataacgatagaacgcgactggaagaacctgtacgttatcaaacgagtcacggaa  
atcaggaagtgttattgataaacttagaccaacttgccgaacaattacacgttaccaggtggatacaggtgggtctgtgtatgcgttcttaa  
tgggagttgttgaatttggaataaaaacgaatcaccactgagccaagataccaactggacagtcgaatccaaggcaagtgtatgtgtttgtgaa  
ggactaa

## SEQ ID NO: 100

Met Tyr Thr Leu Phe Ile Arg Ser Phe Tyr Asp Thr Asn Asn Asp Gly Val Gly Asp Tyr Asn Gly Val  
Ala Gln Lys Val Asp Tyr Leu Lys Thr Leu Gly Val Asp Thr Val Trp Phe Leu Pro Phe Asn Lys Ala  
Lys Ser Tyr His Gly Tyr Asp Val Glu Asp Tyr Tyr Asp Val Glu Pro Asp Tyr Gly Thr Tyr Ala Gln  
Leu Glu Asn Met Ile Lys Thr Leu Asn Gln Asn Gly Ile Arg Val Val Met Asp Leu Val Val Asn His  
Thr Ser Asp Thr His Ser Trp Phe Leu Asp Ala Val Glu Asn Thr Thr Asn Ser Lys Tyr Trp Ser Tyr  
Tyr Ile Met Thr Leu Glu Asn Arg Asp Gly Trp Asn His Trp His Trp Lys Ile Asn Ser Lys Gly Gln  
Lys Val Tyr Tyr Phe Gly Leu Phe Asp Ser Ser Met Pro Asp Leu Asn Phe Asp Asn Pro Gln Val  
Met Asn Glu Ile Lys Arg Ile Ile Asp Phe Trp Ile Thr Val Gly Val Asp Gly Phe Arg Leu Asp Ala  
Pro Lys His Tyr Lys Gly Trp Asp Trp Asp Asp Gly Ile Ser Gly Ser Ala Ala Ile Ala Arg Glu Ile Glu  
Ser Tyr Ile Arg Ser Lys Leu Gly Asn Asp Ala Ile Val Val Gly Glu Val Tyr Asp Gly Asn Pro Ser  
Val Leu Ser Gln Phe Ala Pro Met Pro Ala Phe Asn Phe Thr Phe Met Tyr Gly Ile Thr Gly Asn His  
Glu Gly Lys Asp Asn Leu Leu Gly Glu Thr Ile Ser Trp Val Asn Gly Ala Ser Tyr Tyr Leu Asn Val  
Lys His Phe Pro Phe Ile Asp Asn His Asp Leu Asn Arg Trp Ile Ser Ile Leu Ile Asp Gln Lys Tyr Ser  
Gly Asn Thr Gln Val Gly Thr Lys Gln Tyr Ile Leu Thr Asn Ala Leu Leu Leu Ser Leu Asn Gly Met  
Pro Val Ile Tyr Tyr Gly Asn Glu Ile Gly Leu Arg Gly Trp Lys Trp Gly Gln Asp Pro Trp Asp Leu  
Pro Val Arg Glu Pro Met Gln Trp Tyr Ala Ser Gln Ser Gly Ala Gly Gln Thr Trp Trp Thr Lys Pro



Figure 16LL

Applicant(s): Walter Callen et al.  
ENZYMES HAVING ALPHA AMYLASE ACTIVITY AND  
METHODS OF USE THEREOF

Val Tyr Gln Gln Lys Gly Ile Thr Phe Gly Asn Ala Asn Val Asp Gly Ala Met Tyr Asp Asp Pro Asn  
Asp Gly Val Ser Val Glu Glu Gln Met Asn Gly Tyr Thr Ile Asn Asn Phe Phe Lys Gln Phe Ile Thr  
Leu Arg Lys Thr Tyr Pro Ala Leu Ser Lys Gly Ser Ile Thr Ile Glu Arg Asp Trp Lys Asn Leu Tyr  
Val Ile Lys Arg Val Tyr Gly Asn Gln Glu Val Leu Val Leu Ile Asn Leu Asp Pro Thr Trp Pro Asn  
Asn Tyr Thr Leu Pro Gly Gly Tyr Arg Trp Val Trp Tyr Ala Phe Phe Asn Gly Ser Leu Phe Glu Phe  
Gly Asn Lys Asn Glu Ser Pro Leu Ser Gln Asp Thr Asn Trp Thr Val Asn Pro Arg Gln Val Tyr Val  
Phe Val Lys Asp

SEQ ID NO: 101

ttgcgattctttccaaagtaatatcccttttccgcaaaacaccagagagtggcagcgaagcgcagtatcaagagacactgaacaattacaaag  
gaaagtaataatgatcaatttgaaaaaaacaccattagcgcccttggtcgcaggtatggtattaggctttgcatccaacgcaatggcggttctag  
aacgcgtttgtacacctctttgaatggaaatgggaagatgttgcacaggagtgtgaaacattctcggacctaaaggctttgccgcagtgaagt  
ctctccgccaactaaatcacaacacggatgcatggtggggccggtatcaacccgttagttatgctttgaaggacgcagcggtaatcgagcc  
aattaaaaatatggtgcaacgttgtaaagctgtaggcgtcgatatatactagtagtgcagtgaataccacatggcagcctacgacagaaattcc  
cigtatgtaccctatagcagtaatgactttaactcctgtacaggagatattgactataataaccgttggcaaacacagcattgtgattagtcggtctta  
atgatctaaaaacaggatctgactacgtccgcaaaaaatagcggattatgaacgacgcaatcagtatgggtgtagctggtttccgtattgatg  
cagccaaacatataccagcaggtgatatactgcccattaaaggtaaatgaatggtaaccatacatctccaagaggtaattggtgcatccggcg  
aacctgttcgaccgactgaatacacctttatcggtggtgtcacggaattcaattgtctgaaaaattgggtccagcctccgcaatgtaattgctt  
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cttttggcgcgggtggttttaggtttgtgtattataaaacgtgctaattgtagcattaatcaagtttgatacgggaatgcctgatggccaatactgt  
aacataatagaagctaactttgatgaaagcaccggccaatgtagtgacgtacagattccaacgggtcaagcgttattaccgtagtggtgggca  
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aaattaacgccatcttttagtgacaatggtgcaataaaaacagctgatctaactgttactggtgcaggtgttataaagacgggacttggagcacctt  
acaaaattgtggtttgaaattaccggtgcacaaaccaatccagtcggtggcgacgaagctggtacttccgaggtactgtaatactggtgggta  
aagcacaattagattatgacgcaactagcgggtttgtattacacaatacaaaagcttaattggtgaagaagcacctgcgcgttttaaaattgataatggt  
agttggactgaagcttatccaacagctgattaccaagttacagataacaattcataccgcattaacttaatagcgatagcaaacgattacagtaa  
acgcacaataa

SEQ ID NO: 102

Met Arg Phe Phe Pro Lys Leu Ile Ser Pro Phe Pro Gln Asn Thr Arg Glu Trp Gln Arg Ser Ala Val  
Ser Arg Asp Thr Glu Gln Leu Gln Arg Lys Val Ile Met Ile Asn Leu Lys Lys Asn Thr Ile Ser Ala  
Leu Val Ala Gly Met Val Leu Gly Phe Ala Ser Asn Ala Met Ala Val Pro Arg Thr Ala Phe Val His  
Leu Phe Glu Trp Lys Trp Glu Asp Val Ala Gln Glu Cys Glu Thr Phe Leu Gly Pro Lys Gly Phe Ala  
Ala Val Gln Val Ser Pro Pro Thr Lys Ser His Asn Thr Asp Ala Trp Trp Gly Arg Tyr Gln Pro Val  
Ser Tyr Ala Phe Glu Gly Arg Ser Gly Asn Arg Ser Gln Phe Lys Asn Met Val Gln Arg Cys Lys Ala  
Val Gly Val Asp Ile Tyr Val Asp Ala Val Ile Asn His Met Ala Ala Tyr Asp Arg Asn Phe Pro Asp  
Val Pro Tyr Ser Ser Asn Asp Phe Asn Ser Cys Thr Gly Asp Ile Asp Tyr Asn Asn Arg Trp Gln Thr  
Gln His Cys Asp Leu Val Gly Leu Asn Asp Leu Lys Thr Gly Ser Asp Tyr Val Arg Gln Lys Ile Ala  
Asp Tyr Met Asn Asp Ala Ile Ser Met Gly Val Ala Gly Phe Arg Ile Asp Ala Ala Lys His Ile Pro  
Ala Gly Asp Ile Ala Ala Ile Lys Gly Lys Leu Asn Gly Asn Pro Tyr Ile Phe Gln Glu Val Ile Gly Ala  
Ser Gly Glu Pro Val Arg Pro Thr Glu Tyr Thr Phe Ile Gly Gly Val Thr Glu Phe Gln Phe Ala Arg  
Lys Leu Gly Pro Ala Phe Arg Asn Ser Asn Ile Ala Trp Leu Lys Asp Ile Gly Ser Gln Met Glu Leu  
Ser Ser Ala Asp Ala Val Thr Phe Val Thr Asn His Asp Glu Glu Arg His Asn Pro Asn Gly Pro Ile  
Trp His Gly Val Gln Gly Asn Gly Tyr Ala Leu Ala Asn Ile Phe Thr Leu Ala Tyr Pro Tyr Gly Tyr  
Pro Lys Ile Met Ser Gly Tyr Phe Phe His Gly Asp Phe Asn Ala Ala Pro Pro Ser Ser Gly Ile His Thr

Figure 16MM



Gly Asn Ala Cys Gly Phe Asp Gly Gly Asp Trp Val Cys Glu His Lys Trp Arg Gly Ile Ala Asn Met  
Val Ala Phe Arg Asn Tyr Thr Ala Ser Glu Trp Arg Ile Ser Asn Trp Trp Gln Asn Ser Asn Asp Gln  
Ile Ala Phe Gly Arg Gly Gly Leu Gly Phe Val Val Ile Asn Lys Arg Ala Asn Gly Ser Ile Asn Gln  
Ser Phe Asp Thr Gly Met Pro Asp Gly Gln Tyr Cys Asn Ile Ile Glu Ala Asn Phe Asp Glu Ser Thr  
Gly Gln Cys Ser Ala Ala Thr Asp Ser Asn Gly Gln Ala Val Ile Thr Val Ser Gly Gly Gln Ala Asn  
Phe Asn Val Ala Gly Asp His Ala Ala Ala Ile His Val Gly Ala Lys Ile Gly Asp Gln Cys Ser Gly  
Asp Asp Cys Pro Cys Thr Gly Ser Asp Cys Asn Asn Asp Pro Lys Pro Asp Phe Ala Val Pro Ala  
Thr Ser Ile Cys Thr Ser Glu Asn Leu Pro Thr Leu Tyr Tyr Trp Gly Ala Gln Pro Thr Asp Ser Leu  
Ala Asn Ala Ala Trp Pro Gly Val Ala Met Gln Thr Asn Gly Asp Phe Lys Cys His Asp Leu Gly Val  
Glu Leu Thr Lys Ile Asn Ala Ile Phe Ser Asp Asn Gly Ala Asn Lys Thr Ala Asp Leu Thr Val Thr  
Gly Ala Gly Cys Tyr Lys Asp Gly Thr Trp Ser Thr Leu Gln Asn Cys Gly Phe Glu Ile Thr Gly Ala  
Gln Thr Asn Pro Val Gly Gly Asp Glu Val Trp Tyr Phe Arg Gly Thr Ala Asn Asp Trp Gly Lys Ala  
Gln Leu Asp Tyr Asp Ala Thr Ser Gly Leu Tyr Tyr Thr Ile Gln Ser Phe Asn Gly Glu Glu Ala Pro  
Ala Arg Phe Lys Ile Asp Asn Gly Ser Trp Thr Glu Ala Tyr Pro Thr Ala Asp Tyr Gln Val Thr Asp  
Asn Asn Ser Tyr Arg Ile Asn Phe Asn Ser Asp Ser Lys Ala Ile Thr Val Asn Ala Gln

## SEQ ID NO: 103

gtgctaacgtttaccgcatcattcgaaaaggatggatgttctgctcgctgttttgcactgcctcgctgttctgcccacaggacagcccgcca  
aggctgccgcaccgtttaacggcaccatgatgcagtatattgaatggtacttgccggatgatggcacgttatggacaaaagtggccaatgaagc  
caacaactatccagccttggcatcaccgctcttggctgccgcccgttacaaaggaacaagccgcagcgacgtagggtacggagtatacga  
cttgatgacctggcgcaattcaatcaaaaaggaccgtccgcacaaaatacgaacaaaagctcaatatctcaagccattcaagccgccac  
gccgctggaatgcaagtgtacgccgatgtcgtgttcgaccataaaggcgccgacggcaggaatgggtggacgccgtcgaagtcaatc  
cgtccgaccgcaaccaagaatctcgggcacatatcaaatcaagcatggacgaaatttgatttcccgggcggggcaacacactaccagctt  
taagtggcgctggtaccatttgacggcggtgattgggacgaaagccgaaaattgagccgcattacaaattccgggcacatggcaagcggtg  
gattgggaagtagacacggaaaacggaaactatgactactaatgtatgccaccttgatgatggatcatccgaagtcgtgaccgagctgaaaa  
actggggggaatggtatgtcaacacaacgaacattgatgggttcgggttgatgccgtcaagcatattaagttcagtttttttctgattggttgcgt  
atgtgcgttctcagactggcaagccgctatttaccgtcggggaatattggagctatgacatcaacaagttgcacaattacattacgaaaacaaacg  
gaacgatgtctttgttgatgccccgttacacaacaaatattataccgcttcaaatcagggggcgcatgtgatgcgcacgttaattgaccaatact  
ctcatgaaagatcaaccgacattggccgctaccttcgttgataatcatgacaccgaacccggccaagcgctgcagtcagtcagccatggt  
tcaaacgggttgcttacgcttatttctaactcggcaggaaggatacccgctgcgtctttatggtgactattatggcattccacaataacattccttc  
gctgaaaagcaaaatcgatccgctcctcatcgcgcgagggattatgcttacggaacgcaacatgattatcttgatcactccgacatcatcggt  
ggacaaggggaaggggtcactgaaaaaccaggatccgggctggccgactgatcaccgatgggcccgggaggaagcaaatggatgtacgttg  
gcaaacacacgctggaaaagtgttctatgacctaccggcaaccggagtgacaccgtcaccatcaacagtgatggatgggggggaattcaaa  
gtcaatggcggttcggttgcgttgggttcctagaaaaacgaccgtttctaccatcgctcggccgatcacaacccgaccgtggactggtgaattc  
gtccgttggaccgaaccacggttggtggcatggcctga

## SEQ ID NO: 104

Val Leu Thr Phe His Arg Ile Ile Arg Lys Gly Trp Met Phe Leu Leu Ala Phe Leu Leu Thr Ala Ser  
Leu Phe Cys Pro Thr Gly Gln Pro Ala Lys Ala Ala Ala Pro Phe Asn Gly Thr Met Met Gln Tyr Phe  
Glu Trp Tyr Leu Pro Asp Asp Gly Thr Leu Trp Thr Lys Val Ala Asn Glu Ala Asn Asn Leu Ser Ser  
Leu Gly Ile Thr Ala Leu Trp Leu Pro Pro Ala Tyr Lys Gly Thr Ser Arg Ser Asp Val Gly Tyr Gly  
Val Tyr Asp Leu Tyr Asp Leu Gly Glu Phe Asn Gln Lys Gly Thr Val Arg Thr Lys Tyr Gly Thr  
Lys Ala Gln Tyr Leu Gln Ala Ile Gln Ala Ala His Ala Ala Gly Met Gln Val Tyr Ala Asp Val Val  
Phe Asp His Lys Gly Gly Ala Asp Gly Thr Glu Trp Val Asp Ala Val Glu Val Asn Pro Ser Asp Arg  
Asn Gln Glu Ile Ser Gly Thr Tyr Gln Ile Gln Ala Trp Thr Lys Phe Asp Phe Pro Gly Arg Gly Asn  
Thr Tyr Ser Ser Phe Lys Trp Arg Trp Tyr His Phe Asp Gly Val Asp Trp Asp Glu Ser Arg Lys Leu  
Ser Arg Ile Tyr Lys Phe Arg Gly Ile Gly Lys Ala Trp Asp Trp Glu Val Asp Thr Glu Asn Gly Asn  
Tyr Asp Tyr Leu Met Tyr Ala Asp Leu Asp Met Asp His Pro Glu Val Val Thr Glu Leu Lys Asn  
Trp Gly Glu Trp Tyr Val Asn Thr Thr Asn Ile Asp Gly Phe Arg Leu Asp Ala Val Lys His Ile Lys  
Phe Ser Phe Phe Pro Asp Trp Leu Ser Tyr Val Arg Ser Gln Thr Gly Lys Pro Leu Phe Thr Val Gly



Figure 16NN

Glu Tyr Trp Ser Tyr Asp Ile Asn Lys Leu His Asn Tyr Ile Thr Lys Thr Asn Gly Thr Met Ser Leu  
Phe Asp Ala Pro Leu His Asn Lys Phe Tyr Thr Ala Ser Lys Ser Gly Gly Ala Phe Asp Met Arg Thr  
Leu Met Thr Asn Thr Leu Met Lys Asp Gln Pro Thr Leu Ala Val Thr Phe Val Asp Asn His Asp  
Thr Glu Pro Gly Gln Ala Leu Gln Ser Trp Val Asp Pro Trp Phe Lys Pro Leu Ala Tyr Ala Phe Ile  
Leu Thr Arg Gln Glu Gly Tyr Pro Cys Val Phe Tyr Gly Asp Tyr Tyr Gly Ile Pro Gln Tyr Asn Ile  
Pro Ser Leu Lys Ser Lys Ile Asp Pro Leu Leu Ile Ala Arg Arg Asp Tyr Ala Tyr Gly Thr Gln His  
Asp Tyr Leu Asp His Ser Asp Ile Ile Gly Trp Thr Arg Glu Gly Val Thr Glu Lys Pro Gly Ser Gly  
Leu Ala Ala Leu Ile Thr Asp Gly Pro Gly Gly Ser Lys Trp Met Tyr Val Gly Lys Gln His Ala Gly  
Lys Val Phe Tyr Asp Leu Thr Gly Asn Arg Ser Asp Thr Val Thr Ile Asn Ser Asp Gly Trp Gly Glu  
Phe Lys Val Asn Gly Gly Ser Val Ser Val Trp Val Pro Arg Lys Thr Thr Val Ser Thr Ile Ala Arg  
Pro Ile Thr Thr Arg Pro Trp Thr Gly Glu Phe Val Arg Trp Thr Glu Pro Arg Leu Val Ala Trp Pro

SEQ ID NO: 105

atgtccctattcaaaaaatcttccgtggattgtatctactctcttttcttttctgtttattgctccttttccattcaaacagaaaaagtcgcgctggaa  
gtgttccagtgaatggaacgatgatgaataatttccgaatggatccctccagacgatggaacactatggacgaaagtagcaaataacgccaatct  
ttagcgaatttggcattactgccctttggcttccccctgcctataaaggaacaaagcagcagtgacgttgatattggcgtttatgatttatgacct  
aggagagttaatacaaaaaggaaactgtccgaacaaaatacggaaacaaaacacaatatccaagcaatccaagcggcgcatacagcaggaa  
tgcaagtatatgcagatgtcgtctttaaccataaagccggtgcagatgggacagaactagtggtatgcagtagaagtaaaccctctgaccgcaat  
caagaaatatcaggaacatatcaaatccaagcgtggacaaaatttgatttctggtcgtgaaacacctattctagttaaatggcgttggtatca  
tttcgatggaacggactgggatgagagtagaaaactaaatcgtatttacaattccgcggcacgggaaaagcatgggattgggaagtatagataca  
gaaaatgggaattatgactatctcatgtatgcagatttggatatggatcatccagaggttgatctgaactaaaaaattggggaaaagtggatgtaa  
ccacaaccaatcgcagggattccgtctggatgcagtgaagcatattaaatatagcctttccagactggctatcgtatgtacgaacccaaacac  
aaaagcctcttttggcgttggcgaattttggagctatgacattaaacagctacacaactatattacaagacgaacggctctatgtccctattcgt  
gccccgtgcataacaatttttatatagcatcgaatcaggtggctattttgatatgcgcacattactcaacaacacattgatgaaagatcaaccaa  
cactatcggtcacattagtagacaatcacgatactgagccagggaacatctttgcagtcgtgggtcgagccgtggttaaacctgttagcttgcgat  
ttatcttgaaccgccaagaaggttatccgtgcattttatggagattactatggtattccaaaatacaacattcctgcgctgaaaagcaaaattgatc  
cgctgttaattgctcgaagagattatgcctacggaacacagcagcactatattgacaatgcagatattatcggtggtgacgcgggaaggagtagct  
gaaaaagcaaatcgggactgtcgcactaccgacggacgtggcgaagcaaatggatgtatgttggcaacaacacgctggcaaaaac  
gttttatgatctaaccggcaatcgaagtatacagtgacaatcaacgctgatggatggggagaatttaagtaatggagggtctgtatccatag  
ggttccaaaaacatcaaccacttcccaatcacatttactgtaataatgccacaaccgtttggggacaaaatgtatcagttgtcggaatatttcg  
cagctgggcaac

SEQ ID NO: 106

Met Ser Leu Phe Lys Lys Ile Phe Pro Trp Ile Val Ser Leu Leu Leu Leu Phe Ser Phe Ile Ala Pro Phe  
Ser Ile Gln Thr Glu Lys Val Arg Ala Gly Ser Val Pro Val Asn Gly Thr Met Met Gln Tyr Phe Glu  
Trp Tyr Leu Pro Asp Asp Gly Thr Leu Trp Thr Lys Val Ala Asn Asn Ala Gln Ser Leu Ala Asn Leu  
Gly Ile Thr Ala Leu Trp Leu Pro Pro Ala Tyr Lys Gly Thr Ser Ser Ser Asp Val Gly Tyr Gly Val  
Tyr Asp Leu Tyr Asp Leu Gly Glu Phe Asn Gln Lys Gly Thr Val Arg Thr Lys Tyr Gly Thr Lys  
Thr Gln Tyr Ile Gln Ala Ile Gln Ala Ala His Thr Ala Gly Met Gln Val Tyr Ala Asp Val Val Phe  
Asn His Lys Ala Gly Ala Asp Gly Thr Glu Leu Val Asp Ala Val Glu Val Asn Pro Ser Asp Arg Asn  
Gln Glu Ile Ser Gly Thr Tyr Gln Ile Gln Ala Trp Thr Lys Phe Asp Phe Pro Gly Arg Gly Asn Thr  
Tyr Ser Ser Phe Lys Trp Arg Trp Tyr His Phe Asp Gly Thr Asp Trp Asp Glu Ser Arg Lys Leu Asn  
Arg Ile Tyr Lys Phe Arg Gly Thr Gly Lys Ala Trp Asp Trp Glu Val Asp Thr Glu Asn Gly Asn Tyr  
Asp Tyr Leu Met Tyr Ala Asp Leu Asp Met Asp His Pro Glu Val Val Ser Glu Leu Lys Asn Trp  
Gly Lys Trp Tyr Val Thr Thr Thr Asn Ile Asp Gly Phe Arg Leu Asp Ala Val Lys His Ile Lys Tyr  
Ser Phe Phe Pro Asp Trp Leu Ser Tyr Val Arg Thr Gln Thr Gln Lys Pro Leu Phe Ala Val Gly Glu  
Phe Trp Ser Tyr Asp Ile Asn Lys Leu His Asn Tyr Ile Thr Lys Thr Asn Gly Ser Met Ser Leu Phe  
Asp Ala Pro Leu His Asn Asn Phe Tyr Ile Ala Ser Lys Ser Gly Gly Tyr Phe Asp Met Arg Thr Leu  
Leu Asn Asn Thr Leu Met Lys Asp Gln Pro Thr Leu Ser Val Thr Leu Val Asp Asn His Asp Thr



Figure 1600

Glu Pro Gly Gln Ser Leu Gln Ser Trp Val Glu Pro Trp Phe Lys Pro Leu Ala Tyr Ala Phe Ile Leu  
Thr Arg Gln Glu Gly Tyr Pro Cys Ile Phe Tyr Gly Asp Tyr Tyr Gly Ile Pro Lys Tyr Asn Ile Pro  
Ala Leu Lys Ser Lys Leu Asp Pro Leu Leu Ile Ala Arg Arg Asp Tyr Ala Tyr Gly Thr Gln His Asp  
Tyr Ile Asp Asn Ala Asp Ile Ile Gly Trp Thr Arg Glu Gly Val Ala Glu Lys Ala Asn Ser Gly Leu  
Ala Ala Leu Ile Thr Asp Gly Pro Gly Gly Ser Lys Trp Met Tyr Val Gly Lys Gln His Ala Gly Lys  
Thr Phe Tyr Asp Leu Thr Gly Asn Arg Ser Asp Thr Val Thr Ile Asn Ala Asp Gly Trp Gly Glu Phe  
Lys Val Asn Gly Gly Ser Val Ser Ile Trp Val Pro Lys Thr Ser Thr Thr Ser Gln Ile Thr Phe Thr Val  
Asn Asn Ala Thr Thr Val Trp Gly Gln Asn Val Tyr Val Val Gly Asn Ile Ser Gln Leu Gly Asn

## SEQ ID NO: 107

atggacagcctcgacgcgccggagcagaagccctgggtgaaggatggcaggctctccgctacctggatacagggacagggaccgtggtc  
gctcccaggacacctgcgccccggccggccggcagggaagtcggcccgctggacaagtggaaaaacgatatcatctattcgtcctcac  
cgaccgtttccaggatggcgacaagaccaacaacatggacgtggtcccgcggacatgaaaaaatatcatggcggcgacatccaggggctc  
atcgacaagctcgactatatcaaggagaccggttcgacggccatctggctcacgccccctatgaaggggcagaccactcttcgagaccgac  
aattaccatggttactggccattgacttctatgacacggacccccatgtgggcacatgcagaaattgaggagcttatcgagaagcccatga  
gaaagggctgaagatcgtgctcgatattccctgaaccacacggcctggggagcatccctctacaaggacgacagcaagaaggactggttcc  
accatataggagatgtgaaggactgggaagatccctactgggctgaaaacggctccatattcggtcttctgacctggcgcaggaaaaccctg  
ccgtggaaaagtacatcgacgtggccaagtctgggttagacaagggtattgacggcttcaggcttgacgccgtgaagaacgtgccctca  
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cgcgaaactaccagagagaggacatgagctcactcttcgattaccgcgtctactggacccctgaaggacaccttcgccaaggacgggagcatgc  
gcaacctggcggcgaaagcttgatgagtgacaggaattatcccgacccgggctcatgtcgggtttcttgataaccacgacacgccgaggtt  
cctcaccgagggccaacggcaacaaggataagctcaaacctggccctgccttcgcgatgaccatcaaccgcatgcctaccattattatggcacc  
gaggttgccatggaaggcaactgcgatcatggcgccgtagataaccggaggacatgcagtgaggacaaggatcctgacatgttcaaata  
cttcaagacttcaccactgcccgaatgagcatgaatccctcagggaaggaaagaagctcgagatgtggcaggatgacaaagtctacgcgta  
cgggaggcgagaccccgaaaggacgagtcgtatgtgtgtaacaacggctatgatacgaggaacgggacataccgctccgccccgagag  
cggcataagaacggcacggtgctgaaggatgtcatccggcgaaacctgacggtacagaacggaaaaatccatgcgaaatcgggcgg  
caaacaggcgcggtatctacgtgccgcgtag

## SEQ ID NO: 108

Met Asp Ser Leu Asp Ala Pro Glu Gln Lys Pro Trp Val Lys Asp Gly Arg Leu Ser Ala Tyr Leu Asp  
Thr Gly Thr Gly Thr Val Val Ala Pro Glu Ala Pro Ala Pro Pro Pro Ala Glu Glu Val Arg  
Pro Val Asp Lys Trp Lys Asn Asp Ile Ile Tyr Phe Val Leu Thr Asp Arg Phe Gln Asp Gly Asp Lys  
Thr Asn Asn Met Asp Val Val Pro Thr Asp Met Lys Lys Tyr His Gly Gly Asp Ile Gln Gly Leu Ile  
Asp Lys Leu Asp Tyr Ile Lys Glu Thr Gly Ser Thr Ala Ile Trp Leu Thr Pro Pro Met Lys Gly Gln  
Thr His Phe Phe Glu Thr Asp Asn Tyr His Gly Tyr Trp Pro Ile Asp Phe Tyr Asp Thr Asp Pro His  
Val Gly Thr Met Gln Lys Phe Glu Glu Leu Ile Glu Lys Ala His Glu Lys Gly Leu Lys Ile Val Leu  
Asp Ile Pro Leu Asn His Thr Ala Trp Glu His Pro Phe Tyr Lys Asp Asp Ser Lys Lys Asp Trp Phe  
His His Ile Gly Asp Val Lys Asp Trp Glu Asp Pro Tyr Trp Ala Glu Asn Gly Ser Ile Phe Gly Leu  
Pro Asp Leu Ala Gln Glu Asn Pro Ala Val Glu Lys Tyr Leu Ile Asp Val Ala Lys Phe Trp Val Asp  
Lys Gly Ile Asp Gly Phe Arg Leu Asp Ala Val Lys Asn Val Pro Leu Asn Phe Trp Ala Lys Phe Asp  
Arg Ala Ile His Asp Tyr Ala Gly Lys Asp Phe Leu Leu Val Gly Glu Tyr Phe Asp Gly Asn Pro Ala  
Lys Val Ala Asn Tyr Gln Arg Glu Asp Met Ser Ser Leu Phe Asp Tyr Pro Leu Tyr Trp Thr Leu Lys  
Asp Thr Phe Ala Lys Asp Gly Ser Met Arg Asn Leu Ala Ala Lys Leu Asp Glu Cys Asp Arg Asn  
Tyr Pro Asp Pro Gly Leu Met Ser Val Phe Leu Asp Asn His Asp Thr Pro Arg Phe Leu Thr Glu Ala  
Asn Gly Asn Lys Asp Lys Leu Lys Leu Ala Leu Ala Phe Ala Met Thr Ile Asn Arg Met Pro Thr Ile  
Tyr Tyr Gly Thr Glu Val Ala Met Glu Gly Asn Cys Asp Ile Met Gly Ala Val Asp Asn Arg Arg  
Asp Met Gln Trp Asp Lys Asp Pro Asp Met Phe Lys Tyr Phe Lys Thr Leu Thr Thr Ala Arg Asn  
Glu His Glu Ser Leu Arg Glu Gly Lys Lys Leu Glu Met Trp Gln Asp Asp Lys Val Tyr Ala Tyr Gly  
Arg Gln Thr Pro Lys Asp Glu Ser Ile Val Val Leu Asn Asn Gly Tyr Asp Thr Gln Glu Arg Asp Ile

Figure 16PP



Pro Leu Arg Pro Glu Ser Gly Ile Lys Asn Gly Thr Val Leu Lys Asp Val ile Thr Gly Glu Thr Val  
Thr Val Gln Asn Gly Lys Ile His Ala Lys Cys Gly Gly Lys Gln Ala Arg Ile Tyr Val Pro Ala

SEQ ID NO: 109

atggcaagaaaacgctggccataatcttctgacttctagtgcttcttagtctctcggcagttccggcaaggcagaaactctagagaatgggtgga  
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ctcagcgatatggattccaccagcgagtaagggcatgagcgggtggtattccatgggctacgatccctacgatttcttgacctcggcgagtacta  
tcagaaggggacagttgagacgcgttcggctcaaaggaagaactggtgaacatgataaacaccgcacactcctacggcataaagggtgatag  
cggacatagtcataaaccaccgcgccgggtggagaccttgagtggaaacccctcgtgaacgactatactggacagacttctcaaaagtcgcctc  
cggtaaatatacggccaactaccttgacttccacccaacagagcttactgttgatgaaggtaaccttggaggataccctgatataatgacaga  
caaaagctgggaccagttactggctctgggagcagcgaagctacgctgcctacctcaggagcataggggttgacgcctggcgttgcact  
acgtcaagggtacggagcatgggtgttaacgactggctcagctggtggggaggctgggcccgttgagagttactgggacagcaacgttgat  
gactcctcaactgggcatacagcagcggcgccaaggcttggacttccgctctactacaagatggacgaagccttcgacaacaccaacatcc  
cggcattagtgatgactcagatagcggcagacagtggtcagccgcgatccctcaaggcggtaacttctgttccaaccacgatacagatat  
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taagcttaacaacctcatctggatacacgatcaccttggctggaggagttactgacattgtttactacgacagcgacgagcttatcttgagaac  
ggctatggcaccaaacaggactgataacctatacaacctcggctcaagcaaaagttggaaggtgggtctacgttccaaagttcggcggttcat  
gcatccacgagtacaccggcaacctcggcggttgatagacaagtacgtctcctccagcggctgggtctatcttgaggccccagcccacgac  
ccggcgcaacggctactacggctactctgtctggagctactgcggtgtgggttga

SEQ ID NO: 110

Met Ala Arg Lys Thr Leu Ala Ile Phe Phe Val Leu Leu Val Leu Leu Ser Leu Ser Ala Val Pro Ala  
Lys Ala Glu Thr Leu Glu Asn Gly Gly Val Ile Met Gln Ala Phe Tyr Trp Asp Val Pro Gly Gly Gly  
Ile Trp Trp Asp Thr Ile Ala Gln Lys Ile Pro Glu Trp Ala Ser Ala Gly Ile Ser Ala Ile Trp Ile Pro Pro  
Ala Ser Lys Gly Met Ser Gly Gly Tyr Ser Met Gly Tyr Asp Pro Tyr Asp Phe Phe Asp Leu Gly Glu  
Tyr Tyr Gln Lys Gly Thr Val Glu Thr Arg Phe Gly Ser Lys Glu Glu Leu Val Asn Met Ile Asn Thr  
Ala His Ser Tyr Gly Ile Lys Val Ile Ala Asp Ile Val Ile Asn His Arg Ala Gly Gly Asp Leu Glu Trp  
Asn Pro Phe Val Asn Asp Tyr Thr Trp Thr Asp Phe Ser Lys Val Ala Ser Gly Lys Tyr Thr Ala Asn  
Tyr Leu Asp Phe His Pro Asn Glu Leu His Cys Cys Asp Glu Gly Thr Phe Gly Gly Tyr Pro Asp Ile  
Cys His Asp Lys Ser Trp Asp Gln Tyr Trp Leu Trp Ala Ser Ser Glu Ser Tyr Ala Ala Tyr Leu Arg  
Ser Ile Gly Val Asp Ala Trp Arg Phe Asp Tyr Val Lys Gly Tyr Gly Ala Trp Val Val Asn Asp Trp  
Leu Ser Trp Trp Gly Gly Trp Ala Val Gly Glu Tyr Trp Asp Thr Asn Val Asp Ala Leu Leu Asn Trp  
Ala Tyr Ser Ser Gly Ala Lys Val Phe Asp Phe Pro Leu Tyr Tyr Lys Met Asp Glu Ala Phe Asp Asn  
Thr Asn Ile Pro Ala Leu Val Asp Ala Leu Arg Tyr Gly Gln Thr Val Val Ser Arg Asp Pro Phe Lys  
Ala Val Thr Phe Val Ala Asn His Asp Thr Asp Ile Ile Trp Asn Lys Tyr Pro Ala Tyr Ala Phe Ile  
Leu Thr Tyr Glu Gly Gln Pro Val Ile Phe Tyr Arg Asp Tyr Glu Glu Trp Leu Asn Lys Asp Lys Leu  
Asn Asn Leu Ile Trp Ile His Asp His Leu Ala Gly Gly Ser Thr Asp Ile Val Tyr Tyr Asp Ser Asp  
Glu Leu Ile Phe Val Arg Asn Gly Tyr Gly Thr Lys Pro Gly Leu Ile Thr Tyr Ile Asn Leu Gly Ser  
Ser Lys Val Gly Arg Trp Val Tyr Val Pro Lys Phe Ala Gly Ser Cys Ile His Glu Tyr Thr Gly Asn  
Leu Gly Gly Trp Ile Asp Lys Tyr Val Ser Ser Ser Gly Trp Val Tyr Leu Glu Ala Pro Ala His Asp  
Pro Ala Asn Gly Tyr Tyr Gly Tyr Ser Val Trp Ser Tyr Cys Val Gly

SEQ ID NO: 111

atgcccgcgttcaaatcaaggatgacacatgaagttgaagtaccttgccttagtttggctgtggcttcgataggcctcctcgcactccagt  
gggtgctccgaagtactccgaactcgaagaggcggtgtataatgcaggccttctactgggacgtccctaccgggtgggatctggtgggacac  
cataagacagaaaatcccggagtgtgacgacgctggaatctcggcgatattgattctccagctagcaaaaggtatgggtggtgcatactccatg  
ggttatgaccctacgatttcttgacctcggcgagtactatcagaagggaacagttgagacgcgttcggctcaaaggagggaactggtgaaca  
tgataaacaccgcacactcctatggcataaaggatgatacggacatagtcataaaccaccgcgccggcgccgacctggagtggaaaccccttg  
taaacactatacttgacagacttctcaaggctgcctccggttaatacacggccaactaccttgacttccacccaacagaggtcaagtgtgc  
gatgagggtacatttggtagcttccggacatcgccacgagaagagctgggatcagtactggctctgggcaagcaatgagagctacgccgcc

Figure 16QQ



tatctccggagcatagggatcgatgcattgcttgcactacgtcaaaggttacggagcgtgggtgttaacgactggctcagctgggtggggag  
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tacaagatggacgaagccttgacaacaccaacatccccgctttggtttacgcccctcagaacggaggaacagtcgttcccgcgacccctcaa  
ggcagtaactttcgttgccaaccacgataccgataataatctggaacaagtatccggcttatgcgttcaccttacctatgagggacagcctgttat  
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ctactacgataacgatgagctaataattcatgagggaggggctacgggagcagccgggctcataacctacataaacctcgaaacgactggg  
ccgagcgttgggtgaacgtcggtcaaagtttgcgggtacacaatccatgaatacacaggcaatctcggttggttgacaggtgggttc  
agtacgacggatgggttaaactgacggcacctcctcacgatccagccaacggatattacggctactcagcttgagctacgagcgctcgat  
ga

SEQ ID NO: 112

Met Pro Ala Phe Lys Ser Lys Val Met His Met Lys Leu Lys Tyr Leu Ala Leu Val Leu Leu Ala Val  
Ala Ser Ile Gly Leu Leu Ser Thr Pro Val Gly Ala Ala Lys Tyr Ser Glu Leu Glu Glu Gly Gly Val Ile  
Met Gln Ala Phe Tyr Trp Asp Val Pro Thr Gly Gly Ile Trp Trp Asp Thr Ile Arg Gln Lys Ile Pro  
Glu Trp Tyr Asp Ala Gly Ile Ser Ala Ile Trp Ile Pro Pro Ala Ser Lys Gly Met Gly Gly Ala Tyr Ser  
Met Gly Tyr Asp Pro Tyr Asp Phe Phe Asp Leu Gly Glu Tyr Tyr Gln Lys Gly Thr Val Glu Thr  
Arg Phe Gly Ser Lys Glu Glu Leu Val Asn Met Ile Asn Thr Ala His Ser Tyr Gly Ile Lys Val Ile  
Ala Asp Ile Val Ile Asn His Arg Ala Gly Gly Asp Leu Glu Trp Asn Pro Phe Val Asn Asn Tyr Thr  
Trp Thr Asp Phe Ser Lys Val Ala Ser Gly Lys Tyr Thr Ala Asn Tyr Leu Asp Phe His Pro Asn Glu  
Val Lys Cys Cys Asp Glu Gly Thr Phe Gly Asp Phe Pro Asp Ile Ala His Glu Lys Ser Trp Asp Gln  
Tyr Trp Leu Trp Ala Ser Asn Glu Ser Tyr Ala Ala Tyr Leu Arg Ser Ile Gly Ile Asp Ala Trp Arg  
Phe Asp Tyr Val Lys Gly Tyr Gly Ala Trp Val Val Asn Asp Trp Leu Ser Trp Trp Gly Gly Trp Ala  
Val Gly Glu Tyr Trp Asp Thr Asn Val Asp Ala Leu Leu Asn Trp Ala Tyr Asn Ser Gly Ala Lys Val  
Phe Asp Phe Pro Leu Tyr Tyr Lys Met Asp Glu Ala Phe Asp Asn Thr Asn Ile Pro Ala Leu Val Tyr  
Ala Leu Gln Asn Gly Gly Thr Val Val Ser Arg Asp Pro Phe Lys Ala Val Thr Phe Val Ala Asn His  
Asp Thr Asp Ile Ile Trp Asn Lys Tyr Pro Ala Tyr Ala Phe Ile Leu Thr Tyr Glu Gly Gln Pro Val Ile  
Phe Tyr Arg Asp Tyr Glu Glu Trp Leu Asn Lys Asp Lys Leu Asn Asn Leu Ile Trp Ile His Glu His  
Leu Ala Gly Gly Ser Thr Lys Ile Leu Tyr Tyr Asp Asn Asp Glu Leu Ile Phe Met Arg Glu Gly Tyr  
Gly Ser Lys Pro Gly Leu Ile Thr Tyr Ile Asn Leu Gly Asn Asp Trp Ala Glu Arg Trp Val Asn Val  
Gly Ser Lys Phe Ala Gly Tyr Thr Ile His Glu Tyr Thr Gly Asn Leu Gly Gly Trp Val Asp Arg Trp  
Val Gln Tyr Asp Gly Trp Val Lys Leu Thr Ala Pro Pro His Asp Pro Ala Asn Gly Tyr Tyr Gly Tyr  
Ser Val Trp Ser Tyr Ala Gly Val Gly

SEQ ID NO: 113

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atgggacgctgatgcagtagtatttgaatggtacatgcccattgacggccaacattggaagcgttgcaaacgactcggcataatttgctgaacac  
ggtattactgctgctgattccccggcatataagggaacgagccaagcggatgtgggctacgggtgcttacgaccttatgatttaggggagttt  
catcaaaaaggagcgggttcggacaaagtacggcacaaaaggagagctgcaatctgcgatcaaaaagtcttattcccgcgacattaacgtttacg  
gggatgtggtcatcaaccacaaaggcggcgtgatgcgaccgaagatgaaccgcggtgaagtcgatcccgctgaccgcaaccgcgttaatt  
tcaggagaacaccgaattaaagcctggacacattttcatttccggggcgcggcagcacatacagcgaatttaaatggcattggtaccattttgac  
ggaaccgattgggacgagtcggaaagctgaaccgcattataagtttaaggaaggttggaattgggaagttccaatgaaacggcaac  
tatgattatttgatgatgccgacatcattatgaccatcctgatgtcgcagcagaaattaagagatggggcacttggtatgccaatgaactgcaatt  
ggacgggttccgttgatgctgtcaaacacattaaatttttcttggggattgggttaacatgtcagggaacaaacggggaaggaaatgttta  
cggtagctgaatttggcagaatgacttggcgcgctggaaaactatttgaacaaaacaaatttattcattcagtggttgacgtgccgttcattat  
cagttccatgctgacacagggagggcggtatgatagaggaaattgctgaacggtaggtcgttccaagcatccggttgaaagcggtta  
cattgtcgataaccatgatacacagccggggcaatcgcttgatgcgactgtccaaacatggtttaagccgcttgcttacgcttctcacaag  
ggaatctgataccctcaggtttttctacggggatgtacgggacgaaaggagactccagcgcgaaattcctgccttgaaacacaaaattgaa  
ccgatctaaaagcgagaaaacagtagtgcgtacggagcacagcatgattttcgaccaccatgacattgtcggttgacaagggaaggcgac  
agctcgggtgcaaatcaggtttggcggcatttaaacagacggaccgggtggggcgaagcgaatgtatgtcggccggcaaacgccgggtga

Figure 16RR



Applicant(s): Walter Callen et al.  
 ENZYMES HAVING ALPHA AMYLASE ACTIVITY AND  
 METHODS OF USE THEREOF

gacatggcatgacattaccggaaccgttcggagccggtgtcatcaattcgaaggctggggagagtttcacgtaaaccggcgggtcgggttc  
 atttatgttcaaatagatag

SEQ ID NO: 114

Met Lys Gln Gln Lys Arg Leu Tyr Ala Arg Leu Leu Thr Leu Leu Phe Ala Leu Ile Phe Leu Leu Pro  
 His Ser Ala Ala Ala Ala Asn Leu Asn Gly Thr Leu Met Gln Tyr Phe Glu Trp Tyr Met Pro Asn  
 Asp Gly Gln His Trp Lys Arg Leu Gln Asn Asp Ser Ala Tyr Leu Ala Glu His Gly Ile Thr Ala Val  
 Trp Ile Pro Pro Ala Tyr Lys Gly Thr Ser Gln Ala Asp Val Gly Tyr Gly Ala Tyr Asp Leu Tyr Asp  
 Leu Gly Glu Phe His Gln Lys Gly Thr Val Arg Thr Lys Tyr Gly Thr Lys Gly Glu Leu Gln Ser Ala  
 Ile Lys Ser Leu His Ser Arg Asp Ile Asn Val Tyr Gly Asp Val Val Ile Asn His Lys Gly Gly Ala  
 Asp Ala Thr Glu Asp Val Thr Ala Val Glu Val Asp Pro Ala Asp Arg Asn Arg Val Ile Ser Gly Glu  
 His Arg Ile Lys Ala Trp Thr His Phe His Phe Pro Gly Arg Gly Ser Thr Tyr Ser Asp Phe Lys Trp  
 His Trp Tyr His Phe Asp Gly Thr Asp Trp Asp Glu Ser Arg Lys Leu Asn Arg Ile Tyr Lys Phe Gln  
 Gly Lys Ala Trp Asp Trp Glu Val Ser Asn Glu Asn Gly Asn Tyr Asp Tyr Leu Met Tyr Ala Asp Ile  
 Asp Tyr Asp His Pro Asp Val Ala Ala Glu Ile Lys Arg Trp Gly Thr Trp Tyr Ala Asn Glu Leu Gln  
 Leu Asp Gly Phe Arg Leu Asp Ala Val Lys His Ile Lys Phe Ser Phe Leu Arg Asp Trp Val Asn His  
 Val Arg Glu Lys Thr Gly Lys Glu Met Phe Thr Val Ala Glu Tyr Trp Gln Asn Asp Leu Gly Ala  
 Leu Glu Asn Tyr Leu Asn Lys Thr Asn Phe Asn His Ser Val Phe Asp Val Pro Leu His Tyr Gln Phe  
 His Ala Ala Ser Thr Gln Gly Gly Gly Tyr Asp Met Arg Lys Leu Leu Asn Gly Thr Val Val Ser Lys  
 His Pro Leu Lys Ala Val Thr Phe Val Asp Asn His Asp Thr Gln Pro Gly Gln Ser Leu Glu Ser Thr  
 Val Gln Thr Trp Phe Lys Pro Leu Ala Tyr Ala Phe Ile Leu Thr Arg Glu Ser Gly Tyr Pro Gln Val  
 Phe Tyr Gly Asp Met Tyr Gly Thr Lys Gly Asp Ser Gln Arg Glu Ile Pro Ala Leu Lys His Lys Ile  
 Glu Pro Ile Leu Lys Ala Arg Lys Gln Tyr Ala Tyr Gly Ala Gln His Asp Tyr Phe Asp His His Asp  
 Ile Val Gly Trp Thr Arg Glu Gly Asp Ser Ser Val Ala Asn Ser Gly Leu Ala Ala Leu Ile Thr Asp  
 Gly Pro Gly Gly Ala Lys Arg Met Tyr Val Gly Arg Gln Asn Ala Gly Glu Thr Trp His Asp Ile Thr  
 Gly Asn Arg Ser Glu Pro Val Val Ile Asn Ser Glu Gly Trp Gly Glu Phe His Val Asn Gly Gly Ser  
 Val Ser Ile Tyr Val Gln Arg

SEQ ID NO: 115

atggcgaagtactccgagctggagcagggcggagtcataatgcaggccttctactgggacgttcggagggaggaatctggtgggacacaat  
 acggcagaagatccctgaatggtacgatgcaggcatatccgccatctggatacccccgagcagcaaggcagggcggtcactcgatg  
 ggctagaccctcattactcgtatctgggcgagttttaccagaagggaaccgttgagaccgcttcggctccaaggaagagctcgtcaaca  
 tgaatccacggccaccagtagcgcatcaagggtatagcggacatagtgataaaccaccgcgcaggtggagacctcgaatggaaccatac  
 gtcggcgactataccgtggagcgttctaaaggtcgctccgggaaatacaaggccactacatggactccatccaacaactacagcacct  
 cagacgagggaaacctcgttggtccagacattgatcacctcgtgccctcaaccagtactggctgtggcgagcaacgagagctacgccg  
 cctacctcaggagcatagggatcgatgcgtggcgcttgactacgtaagggtctacggcgctgggtcgtcaaggactggctgagtcagtggtg  
 gggctggggcgctggcgagtagtgaggacaccaacgctgatgcgtcctcaactggcgctacagcagcgcccaaggtcttcgactccc  
 gcttactacaagatggagcagggcctttgacaacaagaacattcccgccctggttacgccatccagaacggtgaaaccgtcgtcagcagggat  
 ccttcaaggccgttacctcgtggctaaccacgatacgaacataatctggaacaagtaccctgcctatgccttcacctgacctacgaaggtcag  
 cccgtcatcttctaccgcgactacgaggagtggtcacaagaaggacaaactcaacaacctcatatggattcacgagcacctggcagggggaag  
 caccaagatccttactacgacgacgatgagctcatcttcatgagggaaggctacggcgacaggccgggttataacctacatcaacctcgtg  
 agcgactggggcgagagatgggtgaacgttggtcacaagttcgcgggtatacaatccacgaatacaccggaaacctcggcggtcgggtcg  
 acaggtacgtccagtagcagcggtgggtcaagcttaccgctccgacacgatccggcaaacggctattacggctactcgtcgtgagctacg  
 ccggagttggaagatctcatcaccatcaccatcactaa

SEQ ID NO: 116

Met Ala Lys Tyr Ser Glu Leu Glu Gln Gly Gly Val Ile Met Gln Ala Phe Tyr Trp Asp Val Pro Glu  
 Gly Gly Ile Trp Trp Asp Thr Ile Arg Gln Lys Ile Pro Glu Trp Tyr Asp Ala Gly Ile Ser Ala Ile Trp  
 Ile Pro Pro Ala Ser Lys Gly Met Gly Gly Ala Tyr Ser Met Gly Tyr Asp Pro Tyr Asp Tyr Phe Asp  
 Leu Gly Glu Phe Tyr Gln Lys Gly Thr Val Glu Thr Arg Phe Gly Ser Lys Glu Glu Leu Val Asn Met

Figure 16SS



Ile Ser Thr Ala His Gln Tyr Gly Ile Lys Val Ile Ala Asp Ile Val Ile Asn His Arg Ala Gly Gly Asp  
Leu Glu Trp Asn Pro Tyr Val Gly Asp Tyr Thr Trp Thr Asp Phe Ser Lys Val Ala Ser Gly Lys Tyr  
Lys Ala His Tyr Met Asp Phe His Pro Asn Asn Tyr Ser Thr Ser Asp Glu Gly Thr Phe Gly Gly Phe  
Pro Asp Ile Asp His Leu Val Pro Phe Asn Gln Tyr Trp Leu Trp Ala Ser Asn Glu Ser Tyr Ala Ala  
Tyr Leu Arg Ser Ile Gly Ile Asp Ala Trp Arg Phe Asp Tyr Val Lys Gly Tyr Gly Ala Trp Val Val  
Lys Asp Trp Leu Ser Gln Trp Gly Gly Trp Ala Val Gly Glu Tyr Trp Asp Thr Asn Val Asp Ala Leu  
Leu Asn Trp Ala Tyr Ser Ser Gly Ala Lys Val Phe Asp Phe Pro Leu Tyr Tyr Lys Met Asp Glu Ala  
Phe Asp Asn Lys Asn Ile Pro Ala Leu Val Tyr Ala Ile Gln Asn Gly Glu Thr Val Val Ser Arg Asp  
Pro Phe Lys Ala Val Thr Phe Val Ala Asn His Asp Thr Asn Ile Ile Trp Asn Lys Tyr Pro Ala Tyr  
Ala Phe Ile Leu Thr Tyr Glu Gly Gln Pro Val Ile Phe Tyr Arg Asp Tyr Glu Glu Trp Leu Asn Lys  
Asp Lys Leu Asn Asn Leu Ile Trp Ile His Glu His Leu Ala Gly Gly Ser Thr Lys Ile Leu Tyr Tyr  
Asp Asp Asp Glu Leu Ile Phe Met Arg Glu Gly Tyr Gly Asp Arg Pro Gly Leu Ile Thr Tyr Ile Asn  
Leu Gly Ser Asp Trp Ala Glu Arg Trp Val Asn Val Gly Ser Lys Phe Ala Gly Tyr Thr Ile His Glu  
Tyr Thr Gly Asn Leu Gly Gly Trp Val Asp Arg Tyr Val Gln Tyr Asp Gly Trp Val Lys Leu Thr Ala  
Pro Pro His Asp Pro Ala Asn Gly Tyr Tyr Gly Tyr Ser Val Trp Ser Tyr Ala Gly Val Gly Arg Ser  
His His His His His His

## SEQ ID NO: 117

ttgcgagtgttctggtgtgccaaagctgagccgcccatttcaggcagagtcacaacaacaagacagggacataacaatgaacacacagcg  
ggaatgctggcgatcgaggtatgctgatcgcccccttggcgcatgcccgatgtcatactgcacgcccctaactggaaatacagtgaagtcaccg  
ccaaggccgatctcatcaaggctgcccggctacaagcaggtgctcatctaccgcctctgaagtcctcgggcaacagagtgggtgggctcgttacc  
agccccaggtatcgccctggtcgacaccccccttggaacaagcaggatctggagcagctgatcgccgcatgagacccggggcattgc  
cgtctacgcggagctggtgctcaaccacatggccaacgaaagctggaagcgcagcgacctcaactaccccggcagcgagctgctgcaaag  
ctacgcgggcaatccggcctactttgaacgccagaagctctttggcgatctggggcagaacttctcgcggccaggtttcatccggagggg  
tgcataccgactggaacaatccgggccaatgtccagttactggcgactgtgcccggggcggtgacaaggggctgccggatctggacccca  
acaactgggtggtgaaccagcaacaggttacctgcaggcgctcaaggggatggggatcaaggggttttcgggtcgatcggtcaagcacatg  
agcgattaccagatcaacgcctgtttacccccgagatcaaacaggggatgcacgtctttggcgaggtgatcaccacggggggcgccggca  
acagcgactatgagaacttctcaaacctacctcgacagcagcgggccagggggcctacgacttcccgccttctgcctccctgcgtggagcgc  
tgggtacggcgagcatgaacctgtgcccgatcccggtgcctatggtcaggcgctgcccgggtagccgcgccgtcaccttcgccatcacc  
cagcatccccaccaacgacggtttccgctaccagatcctcaaccagaccgacgagagactggcctatgcctacctgctcggtcgcgatggc  
ggttcgctctggttactccgatcacgggtgaaccaggggacaaggacggattgcgctggcaggactactatctcgccaccgatctcaaaggg  
atgatccgcttcataacacagtgcagggtcaaccgatgcagctcatcggcagtaacgactgcttcgtgctgttaagcgtggcaagcagggc  
gtggtcggaatcaacaagtgcgactacgagcaggagtactggctcgataccgccagattcgagatgaactggtatcgcaactaccgggatgtg  
ctcgaccagaatgccgtggtcaacgtgcagagccagtggtgaaggctgacctccccggcccgccgagccagaatgtggctgcaggagtga

## SEQ ID NO: 118

Met Arg Val Phe Leu Val Val Pro Lys Leu Ser Arg Pro Phe Gln Ala Glu Ser Gln Gln Gln Asp Arg  
Asp Ile Thr Met Lys His Thr Ala Gly Met Leu Ala Ile Ala Gly Met Leu Ile Ala Pro Leu Ala His  
Ala Asp Val Ile Leu His Ala Phe Asn Trp Lys Tyr Ser Glu Val Thr Ala Lys Ala Asp Leu Ile Lys  
Ala Ala Gly Tyr Lys Gln Val Leu Ile Ser Pro Pro Leu Lys Ser Ser Gly Asn Glu Trp Trp Ala Arg  
Tyr Gln Pro Gln Asp Leu Arg Leu Val Asp Thr Pro Leu Gly Asn Lys Gln Asp Leu Glu Gln Leu Ile  
Ala Ala Met Gln Thr Arg Gly Ile Ala Val Tyr Ala Asp Val Val Leu Asn His Met Ala Asn Glu Ser  
Trp Lys Arg Ser Asp Leu Asn Tyr Pro Gly Ser Glu Leu Leu Gln Ser Tyr Ala Gly Asn Pro Ala Tyr  
Phe Glu Arg Gln Lys Leu Phe Gly Asp Leu Gly Gln Asn Phe Leu Ala Gly Gln Asp Phe His Pro  
Glu Gly Cys Ile Thr Asp Trp Asn Asn Pro Gly His Val Gln Tyr Trp Arg Leu Cys Gly Gly Ala Gly  
Asp Lys Gly Leu Pro Asp Leu Asp Pro Asn Asn Trp Val Val Asn Gln Gln Gln Ala Tyr Leu Gln  
Ala Leu Lys Gly Met Gly Ile Lys Gly Phe Arg Val Asp Ala Val Lys His Met Ser Asp Tyr Gln Ile  
Asn Ala Val Phe Thr Pro Glu Ile Lys Gln Gly Met His Val Phe Gly Glu Val Ile Thr Thr Gly Gly  
Ala Gly Asn Ser Asp Tyr Glu Asn Phe Leu Lys Pro Tyr Leu Asp Ser Ser Gly Gln Gly Ala Tyr Asp  
Phe Pro Leu Phe Ala Ser Leu Arg Gly Ala Leu Gly Tyr Gly Gly Ser Met Asn Leu Leu Ala Asp Pro



Figure 16TT

Gly Ala Tyr Gly Gln Ala Leu Pro Gly Ser Arg Ala Val Thr Phe Ala Ile Thr His Asp Ile Pro Thr  
Asn Asp Gly Phe Arg Tyr Gln Ile Leu Asn Gln Thr Asp Glu Arg Leu Ala Tyr Ala Tyr Leu Leu Gly  
Arg Asp Gly Gly Ser Pro Leu Val Tyr Ser Asp His Gly Glu Thr Arg Asp Lys Asp Gly Leu Arg Trp  
Gln Asp Tyr Tyr Leu Arg Thr Asp Leu Lys Gly Met Ile Arg Phe His Asn Thr Val Gln Gly Gln Pro  
Met Gln Leu Ile Gly Ser Asn Asp Cys Phe Val Leu Phe Lys Arg Gly Lys Gln Gly Val Val Gly Ile  
Asn Lys Cys Asp Tyr Glu Gln Glu Tyr Trp Leu Asp Thr Ala Arg Phe Glu Met Asn Trp Tyr Arg  
Asn Tyr Arg Asp Val Leu Asp Gln Asn Ala Val Val Asn Val Gln Ser Gln Trp Val Arg Leu Thr Ile  
Pro Ala Arg Gly Ala Arg Met Trp Leu Gln Glu

SEQ ID NO: 119

atgcaaacgtttgcattcttattttactcaagaaaggatgggtgtgcatgaattatttgaaaaaagtgtggtgtattacgctatcgtcgtacacctaa  
tcatttccctttcttacacctttttcaacagcacaagctaatactgcacctgttaacggaacaatgatgcaatatttgaatgggacttacctaagtgatgg  
gacgctttggacgaaagtaaaaaatgaagctaccaatctttctcactaggtatcacagcactatggctccctccagcatataaaggaacgagcc  
aaagcgatgtcggatcaggtgtttacgatttatgaccttggggaatttaatacaaaaaggagacgatccgaacgaaatacggaaacaaaaacaca  
atatattcaagccattcaaacgtcccaagccgcagggatgcaagtatatgcggtatgttgatttaataaggaagggcgtgacagtacagaatt  
tgtgatgcatgttgaggtaaaccttctaatacgaatacaagaacatctggcacatatcaaatcaagcatggacaaaatttgatttctggtcgtg  
gaaacacatactccagcttcaaatggcgtgtgtaccattttagtggtacggattgggacgaaagtcgtaaatcaatcgtatttacaattccgcgg  
tacaggaagcgtgggactgggaagtcgatacagaaaacggaactatgattttaatgttcgctgatttagatatggatcacctgaggtgtg  
gacagaattaaaaactggggaacgtgtgtacgtcaatactacaataatcgatggattccgcttagatgccgtaaacatattaaatacagcttttc  
cctgactggctaacatatgtacgtaatacaacaggaaaaatttttccggttggggaattttggagctatgacgtcaataagctgcataattacat  
tacaacaaacaaatgggtcgatgtcattttgatgcaccttgcataacaacitttataccgcttccaaatcgatggatattttgacatgcgtatttat  
tgaataatacattaatgaaagatcaaccttactcgtgtgaacacttgcgataaccacgacacgcaaccagggcaatctttacagtcattgggtcg  
aaccttgggttaaacagcttgccttacgcctttattttaacaagacaagaagggtatcccttgcgtattttacgggtgattatttggaatccctaaatacaat  
atcccggggttaaaaagtaaaatcgacccgcttttaattgctcgtcgtgattacgcttatggaacacaacgtgattacattgatcatcaagacattat  
cggatggacacgagaaggcattgatgcaaaaccgaactctggactggcggttaattaccgacggctcgttggaagtaaatggatgtatgtc  
ggtaaaaagcatgccgggaaagtattttatgatttaactggaatcgaagtgcacagtaaacgattaatgcggatgggtggggagaatttaaaagta  
aacggagatccgctcaatttgggtggctaaaacgtcaaacgtcacatttacagtcataaacgccacaacaacagcggacaaaacgtatatg  
ttgctggcaacattccagagctaggaattgtgcacgggttaa

SEQ ID NO: 120

Met Gln Thr Phe Ala Phe Leu Phe Tyr Ser Lys Lys Gly Trp Val Cys Met Asn Tyr Leu Lys Lys Val  
Trp Leu Tyr Tyr Ala Ile Val Ala Thr Leu Ile Ile Ser Phe Leu Thr Pro Phe Ser Thr Ala Gln Ala Asn  
Thr Ala Pro Val Asn Gly Thr Met Met Gln Tyr Phe Glu Trp Asp Leu Pro Asn Asp Gly Thr Leu  
Trp Thr Lys Val Lys Asn Glu Ala Thr Asn Leu Ser Ser Leu Gly Ile Thr Ala Leu Trp Leu Pro Pro  
Ala Tyr Lys Gly Thr Ser Gln Ser Asp Val Gly Tyr Gly Val Tyr Asp Leu Tyr Asp Leu Gly Glu Phe  
Asn Gln Lys Gly Thr Ile Arg Thr Lys Tyr Gly Thr Lys Thr Gln Tyr Ile Gln Ala Ile Gln Thr Ala  
Gln Ala Ala Gly Met Gln Val Tyr Ala Asp Val Val Phe Asn His Lys Ala Gly Ala Asp Ser Thr Glu  
Phe Val Asp Ala Val Glu Val Asn Pro Ser Asn Arg Asn Gln Glu Thr Ser Gly Thr Tyr Gln Ile Gln  
Ala Trp Thr Lys Phe Asp Phe Pro Gly Arg Gly Asn Thr Tyr Ser Ser Phe Lys Trp Arg Trp Tyr His  
Phe Asp Gly Thr Asp Trp Asp Glu Ser Arg Lys Leu Asn Arg Ile Tyr Lys Phe Arg Gly Thr Gly Lys  
Ala Trp Asp Trp Glu Val Asp Thr Glu Asn Gly Asn Tyr Asp Tyr Leu Met Phe Ala Asp Leu Asp  
Met Asp His Pro Glu Val Val Thr Glu Leu Lys Asn Trp Gly Thr Trp Tyr Val Asn Thr Thr Asn Ile  
Asp Gly Phe Arg Leu Asp Ala Val Lys His Ile Lys Tyr Ser Phe Phe Pro Asp Trp Leu Thr Tyr Val  
Arg Asn Gln Thr Gly Lys Asn Leu Phe Ala Val Gly Glu Phe Trp Ser Tyr Asp Val Asn Lys Leu His  
Asn Tyr Ile Thr Lys Thr Asn Gly Ser Met Ser Leu Phe Asp Ala Pro Leu His Asn Asn Phe Tyr Thr  
Ala Ser Lys Ser Ser Gly Tyr Phe Asp Met Arg Tyr Leu Leu Asn Asn Thr Leu Met Lys Asp Gln  
Pro Ser Leu Ala Val Thr Leu Val Asp Asn His Asp Thr Gln Pro Gly Gln Ser Leu Gln Ser Trp Val  
Glu Pro Trp Phe Lys Gln Leu Ala Tyr Ala Phe Ile Leu Thr Arg Gln Glu Gly Tyr Pro Cys Val Phe  
Tyr Gly Asp Tyr Tyr Gly Ile Pro Lys Tyr Asn Ile Pro Gly Leu Lys Ser Lys Ile Asp Pro Leu Leu Ile  
Ala Arg Arg Asp Tyr Ala Tyr Gly Thr Gln Arg Asp Tyr Ile Asp His Gln Asp Ile Ile Gly Trp Thr

Figure 16UU



Arg Glu Gly Ile Asp Ala Lys Pro Asn Ser Gly Leu Ala Ala Leu Ile Thr Asp Gly Pro Gly Gly Ser  
Lys Trp Met Tyr Val Gly Lys Lys His Ala Gly Lys Val Phe Tyr Asp Leu Thr Gly Asn Arg Ser Asp  
Thr Val Thr Ile Asn Ala Asp Gly Trp Gly Glu Phe Lys Val Asn Gly Gly Ser Val Ser Ile Trp Val  
Ala Lys Thr Ser Asn Val Thr Phe Thr Val Asn Asn Ala Thr Thr Thr Ser Gly Gln Asn Val Tyr Val  
Val Gly Asn Ile Pro Glu Leu Gly Asn Cys Arg Thr Gly

SEQ ID NO: 121

atgctcgccctgtcgtcggcggtgcggcatcgacgcggggcccgacaggccctcgctcgtggagccgctgccgcagcgcggccacgcttc  
cgcaggagtaccgcggcagcggccacgcggccgcccggcgacgtgttcgacactgttcgagtggaagtggccggacatcgccggaggaat  
gcgagaacgtgtcggggccggcggttacgagcggtgcaggtgtcgccgcccagggagcacctggtcagcagggggcgccgtggtg  
gcagcggtaccagccggtgagctactcgggtggcgtgagccgcagcggcgacggggcgtggagttcagcaacatgatcagccggtgcaaggc  
cgccggcgtggacatctacgtggacgccgtcatcaaccacatgacggccggtgcgggggagcaggggagcaacggcaccgcctacaccaagta  
caactacccggcctgtacgcgcagcgggacgtttcaccgcagtgccggtggggcactacaccagcggcccaacgtgcaggactgcga  
actgtcgggggtggtgacctaacaacggcgccggcggtgcagcagaagatcgccgactacctggctcgtggcgcggtggtggcggt  
ggcggtgtttcgcacgcagccgccaagcacatccagccggtggaactggacgccatcgtggaccgcgtgaaccagacgctggcgggcgga  
ggggcgcccgcttccctactggttcgaggtgatcgacaacggcgcgaggggggtgcggcgcgagcactactacggcctgggatacgg  
caccggcgccgcggcggacatcacggagttccgctacaagggcggtggcgacaagtctcgggcagcggcgccagcggctggtggacc  
tgaagaacttctcggcggtgacgtggaacctgatccgctcggacaaggccgctcgtttctggagaaccacgatacgcagcggcgccggcg  
atcggtaccgcgatggcagcggttcgggctggccaacgtgtggtgctgcccagccgtacggctatccgtcgggtgatgtccagctacgc  
ctttgaccgcacctccccctttggccgcgacgccggcccgccctccgaggacggcgcgacgaaggacgtgacgtgcgcgccacgctgga  
gacggcggtgctgggcacctgggtgtgcgagcaccgcgaccccgctcattcagcggtggtgggtttcgccgcgcgatggcgggcacgga  
cctgaaccgctggtgggacaacggcggaacgccattgcttttcgcgcggggacggggcttcgtcgccatcagccgcgagccgaaggtg  
accatggcgccggtgccagcggactgtccccggcacctactgcgacgtgctgaccggcggaaggtgggaacgcctgcgcgggaac  
cagcgtgacgggtcactctcaggcggtggtgcagctgagcatcgtcgagaactcggctcgtggtgatccacctcggggccaagctgtaacggc  
gcgctggcggtatgtgcggagggg

SEQ ID NO: 122

Met Leu Ala Leu Ser Leu Gly Gly Cys Gly Ile Asp Ala Gly Pro Thr Gly Pro Arg Val Val Glu Pro  
Leu Pro Gln Arg Pro Thr Leu Pro Gln Glu Tyr Arg Ala Ser Gly His Ala Ala Ala Gly Asp Val Phe  
Val His Leu Phe Glu Trp Lys Trp Pro Asp Ile Ala Glu Glu Cys Glu Asn Val Leu Gly Pro Ala Gly  
Tyr Glu Ala Val Gln Val Ser Pro Pro Gln Glu His Leu Val Gln Gln Gly Ala Pro Trp Trp Gln Arg  
Tyr Gln Pro Val Ser Tyr Ser Val Ala Leu Ser Arg Ser Gly Thr Gly Val Glu Phe Ser Asn Met Ile  
Ser Arg Cys Lys Ala Ala Gly Val Asp Ile Tyr Val Asp Ala Val Ile Asn His Met Thr Ala Gly Ala  
Gly Thr Gly Ser Asn Gly Thr Ala Tyr Thr Lys Tyr Asn Tyr Pro Gly Leu Tyr Ala Gln Ala Asp Phe  
His Pro Gln Cys Ala Val Gly Asp Tyr Thr Ser Ala Ala Asn Val Gln Asp Cys Glu Leu Leu Gly Leu  
Ala Asp Leu Asn Thr Gly Ala Ala Gly Val Gln Gln Lys Ile Ala Asp Tyr Leu Val Ser Leu Ala Arg  
Leu Gly Val Ala Gly Phe Arg Ile Asp Ala Ala Lys His Ile Gln Pro Val Glu Leu Asp Ala Ile Val  
Asp Arg Val Asn Gln Thr Leu Ala Ala Glu Gly Arg Pro Leu Pro Tyr Trp Phe Ala Glu Val Ile Asp  
Asn Gly Gly Glu Gly Val Arg Arg Glu His Tyr Tyr Gly Leu Gly Tyr Gly Thr Gly Gly Ala Ala Asp  
Ile Thr Glu Phe Arg Tyr Lys Gly Val Gly Asp Lys Phe Leu Gly Ser Gly Gly Gln Arg Leu Val Asp  
Leu Lys Asn Phe Ser Ala Val Thr Trp Asn Leu Met Pro Ser Asp Lys Ala Val Val Phe Leu Glu Asn  
His Asp Thr Gln Arg Gly Gly Gly Ile Gly Tyr Arg Asp Gly Thr Ala Phe Arg Leu Ala Asn Val Trp  
Met Leu Ala Gln Pro Tyr Gly Tyr Pro Ser Val Met Ser Ser Tyr Ala Phe Asp Arg Thr Ser Pro Phe  
Gly Arg Asp Ala Gly Pro Pro Ser Glu Asp Gly Ala Thr Lys Asp Val Thr Cys Ala Pro Thr Leu Glu  
Thr Ala Val Leu Gly Thr Trp Val Cys Glu His Arg Asp Pro Val Ile Gln Arg Met Val Gly Phe Arg  
Arg Ala Met Ala Gly Thr Asp Leu Asn Arg Trp Trp Asp Asn Gly Gly Asn Ala Ile Ala Phe Ser Arg  
Gly Asp Arg Gly Phe Val Ala Ile Ser Arg Glu Pro Lys Val Thr Met Ala Ala Val Pro Ser Gly Leu  
Ser Pro Gly Thr Tyr Cys Asp Val Leu Thr Gly Gly Lys Val Gly Asn Ala Cys Ala Gly Thr Ser Val  
Thr Val Asp Ser Gln Gly Val Val Gln Leu Ser Ile Val Glu Asn Ser Ala Leu Val Ile His Leu Gly  
Ala Lys Leu Arg Arg Ala Gly Gly Cys Ala Glu

Figure 16VV



SEQ ID NO: 123

atgccccaggccattcgcactttttcacgttgagcgtgttcggccttaatcggcggttttctgcttggctcgtcttttctgtcccacccgggcaatcc  
aggcccagacaaccccgggccgtaccgttatggttcacctcttcgagtggaatggaccgacatcgtaaagaatgcgagaatttctcggac  
cgaaaggctttgcccgaatccaggtatcgccgcccaggagcatgcccaggggtcgcaatgggtggaccgctatcagccggcagctacaag  
atcgagagccgctccggcaccggggcggagttcgccaatatggtctcgcgctgcaaagccgctgggggtcgatatctatgtcgatgccgtgatc  
aaccatatgacgactgtcggctccggcactgggtatggctggatcgacctacaccagctacacctatccggggctgtatcagaccaggacttcc  
accactgccccggcgaatggcaacgatgatacagcagctacggcgatcgctgggaagtacaaaactgcgaactgctcaacctagccgacctc  
aacaccggcgctgagtatgtccggggtaaactcgccgcctatatgaacgatctgcggcgctgggggtcgccggatttcggatcgatgccgcc  
aagcacatggataccaacgacatcaacaatatcgttgccgcctgcccacgcgcctacatctaccaggaagtgtcgaccagggcgcgga  
gccaattaccgcccggcgaatacttccagaatggcgatgtgaccgagttcaagtacagccgcgagatctcgcgcatgttcaaaacggccagct  
gacccatatgagccagttcgccactgctggggcttcatgtccagcgacctggcgagtagttttaccgataaccacgacaaccagcgcggtca  
cgcgggcgccggcgatgtcttgacctacaagatggccagctgtacacctgggcaatatcttcgagctagcctggccgtatggctaccaca  
ggctcatgtcgagctacacgttcagcaacggcgaccagggggcccatcgaccaatgtgtacgcaaccacaacgcctgattgtggcaacggcc  
gctgggtctgtgagcaccgctggcgagggaatcgccaacatggtcgcttcgcaactacaccgccccgaccttcagcaccagcaactggtgg  
agcaacggcaacaaccagatcgctttcagccgcgggacctgggcttgtggcgatcaatcggaaggtggcagcctgaaccgaccttcca  
aacggcgctcgccgtcgccacactgcatgtcattcacggcgatttcaatgccagcgccggcacctgttcggcccaactatcgctgtcaac  
ggctccggacaggaaccatcacgggtcaacgcgatggacgggtggcgatctacggcgagccaggctcgccactccggccagtgtaac  
gtgacattcaacgaaaacgccacgaccacctgggggcagaatgtgtatatctcgcgcaacgtcgccgcctgggcagctggaacgcaggca  
gcgcggtcttactctctccgtaactaccaatctggagcaagaccatcgccctgccagccaacaccgccattgagtacaagtacatcaaaaa  
ggatggcgcgggcgaatgtggtgtgggaaagcgcgccaaccgcgtctttaccacccccggcagcgagtgccacgcgaacgatacctg  
gaaatag

SEQ ID NO: 124

Met Pro Gln Ala Ile Arg Thr Phe Ser Arg Trp Thr Leu Phe Gly Leu Ile Gly Val Phe Leu Leu Gly  
Leu Val Phe Ser Val Pro Pro Arg Ala Ile Gln Ala Gln Thr Thr Pro Ala Arg Thr Val Met Val His  
Leu Phe Glu Trp Lys Trp Thr Asp Ile Ala Lys Glu Cys Glu Asn Phe Leu Gly Pro Lys Gly Phe Ala  
Ala Ile Gln Val Ser Pro Pro Gln Glu His Val Gln Gly Ser Gln Trp Trp Thr Arg Tyr Gln Pro Val Ser  
Tyr Lys Ile Glu Ser Arg Ser Gly Thr Arg Ala Glu Phe Ala Asn Met Val Ser Arg Cys Lys Ala Val  
Gly Val Asp Ile Tyr Val Asp Ala Val Ile Asn His Met Thr Thr Val Gly Ser Gly Thr Gly Met Ala  
Gly Ser Thr Tyr Thr Ser Tyr Thr Tyr Pro Gly Leu Tyr Gln Thr Gln Asp Phe His His Cys Gly Arg  
Asn Gly Asn Asp Asp Ile Ser Ser Tyr Gly Asp Arg Trp Glu Val Gln Asn Cys Glu Leu Leu Asn  
Leu Ala Asp Leu Asn Thr Gly Ala Glu Tyr Val Arg Gly Lys Leu Ala Ala Tyr Met Asn Asp Leu  
Arg Gly Leu Gly Val Ala Gly Phe Arg Ile Asp Ala Ala Lys His Met Asp Thr Asn Asp Ile Asn Asn  
Ile Val Gly Arg Leu Pro Asn Ala Pro Tyr Ile Tyr Gln Glu Val Ile Asp Gln Gly Gly Glu Pro Ile Thr  
Ala Gly Glu Tyr Phe Gln Asn Gly Asp Val Thr Glu Phe Lys Tyr Ser Arg Glu Ile Ser Arg Met Phe  
Lys Thr Gly Gln Leu Thr His Met Ser Gln Phe Gly Thr Ala Trp Gly Phe Met Ser Ser Asp Leu Ala  
Val Val Phe Thr Asp Asn His Asp Asn Gln Arg Gly His Gly Gly Ala Gly Asp Val Leu Thr Tyr  
Lys Asp Gly Gln Leu Tyr Thr Leu Gly Asn Ile Phe Glu Leu Ala Trp Pro Tyr Gly Tyr Pro Gln Val  
Met Ser Ser Tyr Thr Phe Ser Asn Gly Asp Gln Gly Pro Pro Ser Thr Asn Val Tyr Ala Thr Thr Thr  
Pro Asp Cys Gly Asn Gly Arg Trp Val Cys Glu His Arg Trp Arg Gly Ile Ala Asn Met Val Ala Phe  
Arg Asn Tyr Thr Ala Pro Thr Phe Ser Thr Ser Asn Trp Trp Ser Asn Gly Asn Asn Gln Ile Ala Phe  
Ser Arg Gly Thr Leu Gly Phe Val Ala Ile Asn Arg Glu Gly Gly Ser Leu Asn Arg Thr Phe Gln Thr  
Gly Leu Pro Val Gly Thr Tyr Cys Asp Val Ile His Gly Asp Phe Asn Ala Ser Ala Gly Thr Cys Ser  
Gly Pro Thr Ile Ala Val Asn Gly Ser Gly Gln Ala Thr Ile Thr Val Asn Ala Met Asp Ala Val Ala Ile  
Tyr Gly Gly Ala Arg Leu Ala Thr Pro Ala Ser Val Asn Val Thr Phe Asn Glu Asn Ala Thr Thr Thr  
Trp Gly Gln Asn Val Tyr Ile Val Gly Asn Val Ala Ala Leu Gly Ser Trp Asn Ala Gly Ser Ala Val  
Leu Leu Ser Ser Ala Asn Tyr Pro Ile Trp Ser Lys Thr Ile Ala Leu Pro Ala Asn Thr Ala Ile Glu Tyr  
Lys Tyr Ile Lys Lys Asp Gly Ala Gly Asn Val Val Trp Glu Ser Gly Ala Asn Arg Val Phe Thr Thr  
Pro Gly Ser Gly Ser Ala Thr Arg Asn Asp Thr Trp Lys



Figure 16WW

## SEQ ID NO: 125

gtggtgcacatgaagtgaagtaccttgccttagtttggctgtggcttcgataggcctactctgactccagtggtgctgccaagtactccg  
aactcgaagaggggcggtgttataatgcaggccttctactgggatgttccggagggggaatctggtgggacaccataagacagaaaatcccg  
gagtggtacgacgctggaatcgcgcgatatggattcctccagctagcaaagggatggcggtgttattccatgggctacgatccctacgattt  
ctttgacctcggcgagtactatcagaagggaacagttgagacgccttcggctcaaaggagggaactggtgaacatgataaacaccgcacactc  
ctatggcataaagggtgatagcggacatagtcataaacaccgcgcgggtggagaccttgagtgaacccctttgtaaacatactattggaca  
gacttctcaaggtcgcctccggttaaatacacggccaactaccttgacttcacccaaacgaggtaagtgtcgcgatgagggtacatttggta  
ctttcggacatcgccacgagaagagctgggatcagctactggctctgggcaagcaatgagagctacgccgcatatctccggagcataggga  
tcgatgcatggcggttcgactacgtcaaagggtacggagcgtgggtgttaatgactggctcagctggtggggaggctgggcccgttgagagta  
ctgggacacgaacgttgatgcactccttaactgggcatacagacgcggtgccaaggtcttgacttcccgcctactacaagatggacgaagcc  
tttgacaacaccaacatccccgcttgggttacgccctccagaacggagggaacagctggttcccgcgatccctcaaggcagtaacttctgtgcc  
aaccacgatacagatataatctggaacaagtatccggcttatgcgttcatccttacctatgaggggacagcctgttatatttaccgcgactacgagg  
agtggtcacaacaggataagcttaacaaccttatctggatcacacgagcaccttgcggagggaagtaccaagatccttactacgataacgatga  
gctaattatcatgaggggagggtacgggagcaagccgggcctataacctacataaacctcgaaacgactgggcccagcgctgggtgaac  
gtcggctcaaggttgcggctacacaatccatgaatacacaggcaatctcgggtggctgggtgacaggtgggttcagtacgatggatgggtta  
aactgacggcacctcctcatgatccagccaacggatattacggctactcagctctggagctacgcaggcgtcggatga

## SEQ ID NO: 126

Val Val His Met Lys Leu Lys Tyr Leu Ala Leu Val Leu Leu Ala Val Ala Ser Ile Gly Leu Leu Ser  
Thr Pro Val Gly Ala Ala Lys Tyr Ser Glu Leu Glu Glu Gly Gly Val Ile Met Gln Ala Phe Tyr Trp  
Asp Val Pro Gly Gly Gly Ile Trp Trp Asp Thr Ile Arg Gln Lys Ile Pro Glu Trp Tyr Asp Ala Gly Ile  
Ser Ala Ile Trp Ile Pro Pro Ala Ser Lys Gly Met Gly Gly Gly Tyr Ser Met Gly Tyr Asp Pro Tyr  
Asp Phe Phe Asp Leu Gly Glu Tyr Tyr Gln Lys Gly Thr Val Glu Thr Arg Phe Gly Ser Lys Glu Glu  
Leu Val Asn Met Ile Asn Thr Ala His Ser Tyr Gly Ile Lys Val Ile Ala Asp Ile Val Ile Asn His Arg  
Ala Gly Gly Asp Leu Glu Trp Asn Pro Phe Val Asn Asn Tyr Thr Trp Thr Asp Phe Ser Lys Val Ala  
Ser Gly Lys Tyr Thr Ala Asn Tyr Leu Asp Phe His Pro Asn Glu Val Lys Cys Cys Asp Glu Gly Thr  
Phe Gly Asp Phe Pro Asp Ile Ala His Glu Lys Ser Trp Asp Gln Tyr Trp Leu Trp Ala Ser Asn Glu  
Ser Tyr Ala Ala Tyr Leu Arg Ser Ile Gly Ile Asp Ala Trp Arg Phe Asp Tyr Val Lys Gly Tyr Gly  
Ala Trp Val Val Asn Asp Trp Leu Ser Trp Trp Gly Gly Trp Ala Val Gly Glu Tyr Trp Asp Thr Asn  
Val Asp Ala Leu Leu Asn Trp Ala Tyr Asp Ser Gly Ala Lys Val Phe Asp Phe Pro Leu Tyr Tyr Lys  
Met Asp Glu Ala Phe Asp Asn Thr Asn Ile Pro Ala Leu Val Tyr Ala Leu Gln Asn Gly Gly Thr Val  
Val Ser Arg Asp Pro Phe Lys Ala Val Thr Phe Val Ala Asn His Asp Thr Asp Ile Ile Trp Asn Lys  
Tyr Pro Ala Tyr Ala Phe Ile Leu Thr Tyr Glu Gly Gln Pro Val Ile Phe Tyr Arg Asp Tyr Glu Glu  
Trp Leu Asn Lys Asp Lys Leu Asn Asn Leu Ile Trp Ile His Glu His Leu Ala Gly Gly Ser Thr Lys  
Ile Leu Tyr Tyr Asp Asn Asp Glu Leu Ile Phe Met Arg Glu Gly Tyr Gly Ser Lys Pro Gly Leu Ile  
Thr Tyr Ile Asn Leu Gly Asn Asp Trp Ala Glu Arg Trp Val Asn Val Gly Ser Lys Phe Ala Gly Tyr  
Thr Ile His Glu Tyr Thr Gly Asn Leu Gly Gly Trp Val Asp Arg Trp Val Gln Tyr Asp Gly Trp Val  
Lys Leu Thr Ala Pro Pro His Asp Pro Ala Asn Gly Tyr Tyr Gly Tyr Ser Val Trp Ser Tyr Ala Gly  
Val Gly

## SEQ ID NO: 127

gtgtgcataaattattgaaaaaagtgtggtgtattacgctatcgtcgtacttaatacatttcttctacgcccttttcaactgcacaagccaacac  
tgcaccagtcaacggaacgatgatgcaataattcgaatgggattaccgaatgatggcacactttggacgaaagtaaaaaacgaagcaagcagt  
ctttcttcttaggtattactgcgttatggttaccctgcatacaagggaacgagccaagggtatgctgggtatggcgtgtacgatttgtatgactt  
aggagaatttaatacaaaaaggacgattcgaacgaaatacgaacaaaaacgcaatattacaagccattcaagcggaacgctggcat  
gcaagtatacgtgatgtcgtatttaatacacaaggcggggcagatagtagagaatgggtgacgcagtcgaagtgaatccttcaatcgaacc  
aagaacatctggcacatatcaaatcaagcatggacaaaatttgatttccctggccgtgggaacacatactcaagctttaatggcgatggtatc  
atttgacggtagcggattgggatgaagccgaaaactaaatcgtattacaatttctggccacaggaaaagcatgggattgggaagtagacaca  
gagaacggaaactatgactacttaattgttgcgtgattagatggatcacctgaagtcgtgacagagctaaaaaactggggaacatggtagctc

Figure 16XX



aatacgacaaatgtc gatgggttcgcttagatgcagtaaagcatattaaatatagcttctccagattgggtaacacatgtgcgttcacaaacacg  
aaaaaatcttttgcagtaggagaattttggagctacgatgtcaataaactgcataactacattacaaaaacaagtgaaccatgtcgttatttgatg  
cgccacttcataacaacttttactgcttcaaaatctagcgggtattttgacatgcgctattttgtaataatacgttgatgaaagaccagccttctct  
tgcgggtcacactcgttgataatcatgacacgaaccgggacaatcttacaatcatgggtagagccttggttaagccgcttgcttatgcctttatttt  
gacaagacaagaaggatattccttgctattttacggcgactattacggcatccctaaatacaacattccgggattgaaaagttaaactcatccgct  
tctcattgcccgtagagactacgcatacgggaacacacacgtgattatattgacatcaagacattattggatggacacgggaaggaaattgactcaa  
aaccgaactctggacttgcggcttaattactgacggccctgggtgaagtaaatggatgtatgtaggtaaaaagcatgctggaaaagtgttttacg  
atctcactggaaatcgaaagcgatacggtaacgattatgcagacggctggggagagtttaaagtaaacgggtggctccgtttccatttgggttgc  
aaaacatcacaagtcacgtttaccgtcaacaatgcgacaacgataagcgggacaaaatgtgtatgtcgttggttaacattccagagctcggaaattg  
gaacacagcaaacgcaatcaaaatgaccccatcttcttccaacgtggaaagcaaccattgctcttcacaaaggaaaagccattgaatttaaatt  
tattaaaaagaccaatcggaatgtgtttgggaaagcattccaaaccgaacatacaccgttccatttttatcaacaggctcatatacagctagtt  
ggaatgtacctaa

SEQ ID NO: 128

Val Cys Met Asn Tyr Leu Lys Lys Val Trp Leu Tyr Tyr Ala Ile Val Ala Thr Leu Ile Ile Tyr Phe  
Leu Thr Pro Phe Ser Thr Ala Gln Ala Asn Thr Ala Pro Val Asn Gly Thr Met Met Gln Tyr Phe Glu  
Trp Asp Leu Pro Asn Asp Gly Thr Leu Trp Thr Lys Val Lys Asn Glu Ala Ser Ser Leu Ser Ser Leu  
Gly Ile Thr Ala Leu Trp Leu Pro Pro Ala Tyr Lys Gly Thr Ser Gln Gly Asp Val Gly Tyr Gly Val  
Tyr Asp Leu Tyr Asp Leu Gly Glu Phe Asn Gln Lys Gly Thr Ile Arg Thr Lys Tyr Gly Thr Lys Thr  
Gln Tyr Leu Gln Ala Ile Gln Ala Ala Lys Ser Ala Gly Met Gln Val Tyr Ala Asp Val Val Phe Asn  
His Lys Ala Gly Ala Asp Ser Thr Glu Trp Val Asp Ala Val Glu Val Asn Pro Ser Asn Arg Asn Gln  
Glu Thr Ser Gly Thr Tyr Gln Ile Gln Ala Trp Thr Lys Phe Asp Phe Pro Gly Arg Gly Asn Thr Tyr  
Ser Ser Phe Lys Trp Arg Trp Tyr His Phe Asp Gly Thr Asp Trp Asp Glu Ser Arg Lys Leu Asn Arg  
Ile Tyr Lys Phe Arg Gly Thr Gly Lys Ala Trp Asp Trp Glu Val Asp Thr Glu Asn Gly Asn Tyr Asp  
Tyr Leu Met Phe Ala Asp Leu Asp Met Asp His Pro Glu Val Val Thr Glu Leu Lys Asn Trp Gly  
Thr Trp Tyr Val Asn Thr Thr Asn Val Asp Gly Phe Arg Leu Asp Ala Val Lys His Ile Lys Tyr Ser  
Phe Phe Pro Asp Trp Leu Thr His Val Arg Ser Gln Thr Arg Lys Asn Leu Phe Ala Val Gly Glu Phe  
Trp Ser Tyr Asp Val Asn Lys Leu His Asn Tyr Ile Thr Lys Thr Ser Gly Thr Met Ser Leu Phe Asp  
Ala Pro Leu His Asn Asn Phe Tyr Thr Ala Ser Lys Ser Ser Gly Tyr Phe Asp Met Arg Tyr Leu Leu  
Asn Asn Thr Leu Met Lys Asp Gln Pro Ser Leu Ala Val Thr Leu Val Asp Asn His Asp Thr Gln  
Pro Gly Gln Ser Leu Gln Ser Trp Val Glu Pro Trp Phe Lys Pro Leu Ala Tyr Ala Phe Ile Leu Thr  
Arg Gln Glu Gly Tyr Pro Cys Val Phe Tyr Gly Asp Tyr Tyr Gly Ile Pro Lys Tyr Asn Ile Pro Gly  
Leu Lys Ser Lys Ile Asp Pro Leu Leu Ile Ala Arg Arg Asp Tyr Ala Tyr Gly Thr Gln Arg Asp Tyr  
Ile Asp His Gln Asp Ile Ile Gly Trp Thr Arg Glu Gly Ile Asp Ser Lys Pro Asn Ser Gly Leu Ala Ala  
Leu Ile Thr Asp Gly Pro Gly Gly Ser Lys Trp Met Tyr Val Gly Lys Lys His Ala Gly Lys Val Phe  
Tyr Asp Leu Thr Gly Asn Arg Ser Asp Thr Val Thr Ile Asn Ala Asp Gly Trp Gly Glu Phe Lys Val  
Asn Gly Gly Ser Val Ser Ile Trp Val Ala Lys Thr Ser Gln Val Thr Phe Thr Val Asn Asn Ala Thr  
Thr Ile Ser Gly Gln Asn Val Tyr Val Val Gly Asn Ile Pro Glu Leu Gly Asn Trp Asn Thr Ala Asn  
Ala Ile Lys Met Thr Pro Ser Ser Tyr Pro Thr Trp Lys Ala Thr Ile Ala Leu Pro Gln Gly Lys Ala Ile  
Glu Phe Lys Phe Ile Lys Lys Asp Gln Ser Gly Asn Val Val Trp Glu Ser Ile Pro Asn Arg Thr Tyr  
Thr Val Pro Phe Leu Ser Thr Gly Ser Tyr Thr Ala Ser Trp Asn Val Pro

SEQ ID NO: 129

ttgcgttgcgcgctggcagggacgggtgttggtgcgggcggcgtaatgcgctgccgcgacacccgcgtgaacaaaataatgaattatttg  
aataggatgggggtgtcaagaatgacaaaatctcgagagtgcggtgttcattgaaagtattgttgggtgcctgttggtgatggcttgggga  
tcttcgcgtccgcggcgtattgatgcaaggcttctactgggacgccagtaccgggaccagtgttcgttggtggacgcatttggccaagcaag  
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gatgcgcgcaacgggtctggatgtgtatgttgatctggtgtgaaccaccgcaacgggggacgcggaattggaattttcattacaaagatgc  
gtacggcgaagtgggttacggcggtttcaaaagggttttacgattttcaccccaactacaacattcaggatgccaatgttccaacgaggattc



Figure 16YY

Applicant(s): Walter Callen et al.  
ENZYMES HAVING ALPHA AMYLASE ACTIVITY AND  
METHODS OF USE THEREOF

cagcttcgggcgcgatttagcccatgacaatccgtatgtggccgatggactgaaggctgcaggcgattggctgaccaaagccctcgatgttca  
gggatatcgctcgttgattacgtgaaaggcatcagctacaccttcctgaaaagtatctgtcctatggggccatgaacggaaaattgccgctcgggtga  
gtactgggatgccaaacgggatacgtgaactgggtggcggaacacggcgatggaaggcgggcccatgtgttgattttgcgttcgcgagg  
agctgaaaaacatgtgcaatgcggacgggtactacgacatgcgtcgattggaccacgcgggtctggtcggaatcgaccgtggaaggcgg  
gacgtttgtcgaaaaccatgatacggatcgccacgaccccatctacaataacaagcatttggcgtatgctacatcttgacgtcggaagggtatc  
cgacgggtgttctggaaggattactaccaatacgaatgaagccgatcatcgacaacctcatttggatccacgaacacattgcgtacggaacgac  
ccaagagcgttggaagacgaagatgtcttgtgtatgagcggaccggagggaagcggctatttgggtgggcttaacgacaatcgccacca  
gcaaacggtcaccgtacagaccggcttgggtgccaacgtggccttcacgactacaccggcaacggccccgatctccgtaccgacgcctac  
ggtcgggtaaccttgaccattcctgcaaacgggtacgtggcctattcgttcggcgatctccggatccttggccggtcgagaaaaccgtgac  
gcaggagtttgcggggcgctcgacttggatattcgtccggcgataacacgcaatttgcaggtcggcgatatacgccaaggcaaacaa  
gccggttacagcgggaattgtattgggatgccaagactggacgacctccacgtcgattctcctagaagtgcgttcggcttcgggaacgctcatc  
acgacaaagaccgtgaccaattgtcgtcccagggtacccgcgttccttcacgccttcggctaccggatgtgacgtctttccattcgaagctat  
aacacgccttcgacgaaccaaagccggcctactggtaaaaggtacgtatatacgcgccgcaattgcttcagtaa

SEQ ID NO: 130

Met Arg Cys Arg Arg Gly Arg Asp Gly Cys Trp Cys Gly Arg Arg Asn Ala Leu Pro Arg His Pro  
Arg Glu Gln Asn Asn Met Asn Tyr Leu Asn Arg Met Gly Val Ser Arg Met Thr Lys Ser Arg Glu  
Leu Arg Cys Ser Trp Lys Val Phe Val Val Gly Cys Leu Leu Trp Met Ala Trp Gly Ser Ser Ala Ser  
Ala Gly Val Leu Met Gln Gly Phe Tyr Trp Asp Ala Ser Thr Gly Thr Ser Asp Ser Trp Trp Thr His  
Leu Ala Lys Gln Ala Asn Gly Leu Lys Arg Ala Gly Phe Thr Ala Val Trp Ile Pro Pro Val Leu Lys  
Gly Ala Ser Gly Gly Tyr Ser Asn Gly Tyr Asp Pro Phe Asp Asp Tyr Asp Ile Gly Ser Lys Asp Gln  
Lys Gly Thr Val Ala Thr Arg Trp Gly Thr Arg Glu Glu Leu Gln Arg Ala Val Ala Val Met Arg Ala  
Asn Gly Leu Asp Val Tyr Val Asp Leu Val Leu Asn His Arg Asn Gly Asp Asp Gly Asn Trp Asn  
Phe His Tyr Lys Asp Ala Tyr Gly Lys Val Gly Tyr Gly Arg Phe Gln Lys Gly Phe Tyr Asp Phe His  
Pro Asn Tyr Asn Ile Gln Asp Ala Asn Val Pro Asn Glu Asp Ser Ser Phe Gly Arg Asp Leu Ala His  
Asp Asn Pro Tyr Val Ala Asp Gly Leu Lys Ala Ala Gly Asp Trp Leu Thr Lys Ala Leu Asp Val  
Gln Gly Tyr Arg Leu Asp Tyr Val Lys Gly Ile Ser Tyr Thr Phe Leu Lys Ser Tyr Leu Ser Tyr Gly  
Ala Met Asn Gly Lys Phe Ala Val Gly Glu Tyr Trp Asp Ala Asn Arg Asp Thr Leu Asn Trp Trp  
Ala Asn Thr Ala Met Glu Gly Arg Ala His Val Phe Asp Phe Ala Leu Arg Glu Glu Leu Lys Asn  
Met Cys Asn Ala Asp Gly Tyr Tyr Asp Met Arg Arg Leu Asp His Ala Gly Leu Val Gly Ile Asp  
Pro Trp Lys Ala Val Thr Phe Val Glu Asn His Asp Thr Asp Arg His Asp Pro Ile Tyr Asn Asn Lys  
His Leu Ala Tyr Ala Tyr Ile Leu Thr Ser Glu Gly Tyr Pro Thr Val Phe Trp Lys Asp Tyr Tyr Gln  
Tyr Gly Met Lys Pro Ile Ile Asp Asn Leu Ile Trp Ile His Glu His Ile Ala Tyr Gly Thr Thr Gln Glu  
Arg Trp Lys Asp Glu Asp Val Phe Val Tyr Glu Arg Thr Gly Gly Lys Arg Leu Leu Val Gly Leu  
Asn Asp Asn Arg Ala Thr Ser Lys Thr Val Thr Val Gln Thr Gly Phe Gly Ala Asn Val Ala Leu His  
Asp Tyr Thr Gly Asn Gly Pro Asp Leu Arg Thr Asp Ala Tyr Gly Arg Val Thr Leu Thr Ile Pro Ala  
Asn Gly Tyr Val Ala Tyr Ser Val Pro Gly Ile Ser Gly Ser Phe Val Pro Val Glu Lys Thr Val Thr  
Gln Gly Phe Ala Gly Ala Ser Asp Leu Asp Ile Arg Pro Ala Asp Asn Thr Gln Phe Val Gln Val Gly  
Arg Ile Tyr Ala Lys Ala Asn Lys Pro Val Thr Ala Glu Leu Tyr Trp Asp Ala Lys Asp Trp Thr Thr  
Ser Thr Ser Ile Leu Leu Glu Val Arg Ser Ala Ser Gly Thr Leu Ile Thr Thr Lys Thr Val Thr Gln Leu  
Ser Ser Gln Gly Thr Arg Val Ser Phe Thr Pro Ser Ala Thr Gly Trp Tyr Val Phe Ser Ile Arg Ser Tyr  
Asn Thr Pro Ser Thr Asn Pro Lys Pro Ala Tyr Trp Leu Lys Val Thr Tyr Thr Ala Pro Gln Leu Leu  
Gln

SEQ ID NO: 131

atgccgcagctttaccattgccgccgcgtggcgggcgcgccggcgaggcctggccgccttgacgctggccaccacggccctgggc  
atctcgacggccagggccagagtgacccgcgcacggccttcgtgcatctgttcgaatggaagtggaccgacatcgcgcgagtgcgaga  
ccttctcggggcccaagggtcttcggcggtgcaggtgtcggccccgaacgagcacaactgggtgaccagcggtgatggtgcacattatccg  
tggtggatgcgctaccagccggtgagctacagcctggaccgcagccgcagcgccgagtcaggatccaggacatggtcaaccgatgc  
aatgccgtggcggtgggcatctacgtggacgccgtgatcaatcacatgtccggcgccgacggcgccacctcgagcgctggcgcgagctgg



Figure 16ZZ

agctatcacaaactaccctgggctctatggccccaacgacttccaccagccgggtgtgcagcatcaccaactacggggatgccaacaatgtgcag  
cgttgcgagctctcgggcttcaggacctggacactgggagcgcttatgtgcgggcaagatcgccgactatctggtgatctgtcaacatg  
gggtcaagggcttcgggtgatgcggccaagcacatcagccgaccgacctggggccatcatgatcggtcaacagccgcaccggc  
gcgaaccgccccttctggttctggaggtgattggcggcgccggcgaggcagtcgagccgaaccagtacttctcgtcggcgggcgccaggt  
cacctgacccaggttcaactatgggaagcaaatcttcggcaagttcgccgggtggcgccgtctggccgagctgcgcagcttcggtgaaacctg  
ggcctgatgccagcagcaaaagcgattgcttcatcgacaaccacgacaagcagcgcggtcatggcggggtggaactatctgacctacc  
accatggctcgacctagatctggccaacatcttcatgctggttggccttatggctacccggcgctgatgtccagctatgcttcaaccgcagc  
acggcctacgacacgagcttggcccgccacacgacagtgggtggcgccacccgtggccctgggatggtggcgccagccagccggcctgc  
ttcaaccagagcatcggtggctgggtgtgtgagcaccgctggcggggcatcgccaatatggtggccttcgcaacgccacgctgccaactg  
gacctgacccagctgggtgggacaacggcaacaaccagatcgcttccggcggggtgacaagggttcgtggtgatcaaccgcgaagacgc  
cgcgctgacgcgcaactcaagaccagcctgccagccggccagctactgcgatgtcatctccggggacttcaacaatggtcagtcacggggcc  
atgtggtgacggctgatccggcggtacgtgacgctgacggcgccggcccaatggtgcggcgccatccacgtggcgcccgctctggacg  
gcgctctcagccgcccagaccgctcgggtgacgttaacgcgtcgccgatacttttggggacagaacctgttcgtcgtgggaaccaca  
gcgcactgggcaactggtgcggcgccggcgccagccgatgacttgatttcgggttcgggcacgcgcgggaactggcgcgcggtgctca  
atttgcggccaataaccactaccaatacaagtcatcaagaaggacggggctggaacgtggttgggagggcggtggcaatcgctcgtga  
ccacggcgtctggggcggtatcggtgagcacggcgccgaattggcagtag

SEQ ID NO: 132

Met Pro Gln Leu Tyr Pro Leu Pro Pro Arg Trp Arg Arg Ala Ala Arg Gln Gly Leu Ala Ala Leu Thr  
Leu Ala Thr Thr Ala Leu Gly Ile Ser Thr Ala Gln Ala Gln Ser Ala Pro Arg Thr Ala Phe Val His  
Leu Phe Glu Trp Lys Trp Thr Asp Ile Ala Arg Glu Cys Glu Thr Phe Leu Gly Pro Lys Gly Phe Ala  
Ala Val Gln Val Ser Pro Pro Asn Glu His Asn Trp Val Thr Ser Gly Asp Gly Ala Pro Tyr Pro Trp  
Trp Met Arg Tyr Gln Pro Val Ser Tyr Ser Leu Asp Arg Ser Arg Ser Gly Thr Arg Ala Glu Phe Gln  
Asp Met Val Asn Arg Cys Asn Ala Val Gly Val Gly Ile Tyr Val Asp Ala Val Ile Asn His Met Ser  
Gly Gly Thr Gly Gly Thr Ser Ser Ala Gly Arg Ser Trp Ser Tyr His Asn Tyr Pro Gly Leu Tyr Gly  
Pro Asn Asp Phe His Gln Pro Val Cys Ser Ile Thr Asn Tyr Gly Asp Ala Asn Asn Val Gln Arg Cys  
Glu Leu Ser Gly Leu Gln Asp Leu Asp Thr Gly Ser Ala Tyr Val Arg Gly Lys Ile Ala Asp Tyr Leu  
Val Asp Leu Val Asn Met Gly Val Lys Gly Phe Arg Val Asp Ala Ala Lys His Ile Ser Pro Thr Asp  
Leu Gly Ala Ile Ile Asp Ala Val Asn Ser Arg Thr Gly Ala Asn Arg Pro Phe Trp Phe Leu Glu Val  
Ile Gly Ala Ala Gly Glu Ala Val Gln Pro Asn Gln Tyr Phe Ser Leu Gly Gly Gly Gln Val Thr Val  
Thr Glu Phe Asn Tyr Gly Lys Gln Ile Phe Gly Lys Phe Ala Gly Gly Gly Arg Leu Ala Glu Leu Arg  
Ser Phe Gly Glu Thr Trp Gly Leu Met Pro Ser Ser Lys Ala Ile Ala Phe Ile Asp Asn His Asp Lys  
Gln Arg Gly His Gly Gly Gly Gly Asn Tyr Leu Thr Tyr His His Gly Ser Thr Tyr Asp Leu Ala Asn  
Ile Phe Met Leu Ala Trp Pro Tyr Gly Tyr Pro Ala Leu Met Ser Ser Tyr Ala Phe Asn Arg Ser Thr  
Ala Tyr Asp Thr Ser Phe Gly Pro Pro His Asp Ser Gly Gly Ala Thr Arg Gly Pro Trp Asp Gly Gly  
Gly Ser Gln Pro Ala Cys Phe Asn Gln Ser Ile Gly Gly Trp Val Cys Glu His Arg Trp Arg Gly Ile  
Ala Asn Met Val Ala Phe Arg Asn Ala Thr Leu Pro Asn Trp Thr Val Thr Asp Trp Trp Asp Asn  
Gly Asn Asn Gln Ile Ala Phe Gly Arg Gly Asp Lys Gly Phe Val Val Ile Asn Arg Glu Asp Ala Ala  
Leu Thr Arg Asn Phe Lys Thr Ser Leu Pro Ala Gly Gln Tyr Cys Asp Val Ile Ser Gly Asp Phe Asn  
Asn Gly Gln Cys Thr Gly His Val Val Thr Val Asp Ala Gly Gly Tyr Val Thr Leu Thr Ala Gly Pro  
Asn Gly Ala Ala Ala Ile His Val Gly Ala Arg Leu Asp Gly Ala Ser Gln Pro Pro Thr Thr Ala Ser  
Val Thr Phe Asn Ala Ser Ala Asp Thr Phe Trp Gly Gln Asn Leu Phe Val Val Gly Asn His Ser Ala  
Leu Gly Asn Trp Ser Pro Ala Ala Ala Arg Pro Met Thr Trp Ile Ser Gly Ser Gly Thr Arg Gly Asn  
Trp Arg Ala Val Leu Asn Leu Pro Ala Asn Thr Thr Tyr Gln Tyr Lys Phe Ile Lys Lys Asp Gly Ala  
Gly Asn Val Val Trp Glu Gly Gly Gly Asn Arg Val Val Thr Thr Pro Ser Gly Gly Gly Ser Val Ser  
Thr Gly Gly Asn Trp Gln

SEQ ID NO: 133

atgaataatgtgaaaaagtatggtgtattattctataattgctaccttagttatttccctttttcacacctttttcaacagcacaagctaatactgcacctg  
tcaacggaacaatgatgcaattttcgaatgggatttaccgaatgatgggacgcttggacgaaagtaaaaaatgaagctaccaatctttctcgtc



Figure 16AAA

Applicant(s): Walter Callen et al.  
ENZYMES HAVING ALPHA AMYLASE ACTIVITY AND  
METHODS OF USE THEREOF

aggtattacagcgttatggctccctccagcatataaaggaacgagccaaagc gatgttggatatggcgtgtacgatttatatgaccttggggaatt  
taatcaaaaaggacgatccgaacgaaatcacggaacaaaagcacaatatattcaagccatccaagctgccaaagccgcagggatgcaagtat  
atgcagatgtgtatttaatacataaggcgggggctgacggcacagaatttgcgatgcagttgaggtaaaccttctaatacgaaatcaagaacat  
ctggcacatatcaaatcaagcatggacaaaatttgatttcttggtcgtggaaacacatactccagcttcaaatggcgctggtatcattttgacggt  
accgattgggatgaaagtcgtaaattaaatcgtatttcaaaattccgcggtacaggaaaagcgtgggactgggaagtcgatacagaaaacgga  
aactatgattatttaattgttcgctgatttagatatggatcacctgaagttgtgacagagttaaaaaactggggaaaatggtatgtaaatacgacaaa  
ttagacggatttcgttgatgccgtaaaacataftaaatacagcttttccctgactggctaacaatgtacgtaatacaacaggaaaaaatttatt  
gctgtggggaattttggagctatgacgtcaataagctgcataactacattacaaaaaacaatggatcgatgtcgttatttgatgcacctttgcataa  
caacttttatatcgcttccaaatcgatggatattttgacatgcgttatttgaataatacattaatgaaagatcaaccttactcgctgtaacattgt  
cgataaccatgatacacaaccaggtaaatctttacaatcatgggtagaagcttgggttaaaccgcttgccttacgcctttatttacaagacaagag  
gggtatccttgcgtattttacgggtactattacggaatcccgaatacaatattccgggattaaaaagtaaaattgatccgctttaaattgctcgtcgt  
gattatgcttatggaacacaacgtgattacattgatcatcaagacattatcggtaggacacgagaaggcattgatgcaaaaccgaactctggactt  
gcggcttaattaccgacggccctggcggaagtaaatggatgtatgtcggtaaaaaacatgctgggaaagtgtttatgatttaactggaaatcga  
agtacacagtaaacgattaatgcggacggttggggagaatttaagtaaacggcggtcctgcttgcatttgggtggctaaaacatcaaacgtca  
catttacagtcaataacgccacaacaacagtggaacaaacgtatatgttggcaacattccagagctaggcaattctttg

SEQ ID NO: 134

Met Asn Asn Val Lys Lys Val Trp Leu Tyr Tyr Ser Ile Ile Ala Thr Leu Val Ile Ser Phe Phe Thr Pro  
Phe Ser Thr Ala Gln Ala Asn Thr Ala Pro Val Asn Gly Thr Met Met Gln Tyr Phe Glu Trp Asp Leu  
Pro Asn Asp Gly Thr Leu Trp Thr Lys Val Lys Asn Glu Ala Thr Asn Leu Ser Ser Leu Gly Ile Thr  
Ala Leu Trp Leu Pro Pro Ala Tyr Lys Gly Thr Ser Gln Ser Asp Val Gly Tyr Gly Val Tyr Asp Leu  
Tyr Asp Leu Gly Glu Phe Asn Gln Lys Gly Thr Ile Arg Thr Lys Tyr Gly Thr Lys Ala Gln Tyr Ile  
Gln Ala Ile Gln Ala Ala Lys Ala Ala Gly Met Gln Val Tyr Ala Asp Val Val Phe Asn His Lys Ala  
Gly Ala Asp Gly Thr Glu Phe Val Asp Ala Val Glu Val Asn Pro Ser Asn Arg Asn Gln Glu Thr Ser  
Gly Thr Tyr Gln Ile Gln Ala Trp Thr Lys Phe Asp Phe Pro Gly Arg Gly Asn Thr Tyr Ser Ser Phe  
Lys Trp Arg Trp Tyr His Phe Asp Gly Thr Asp Trp Asp Glu Ser Arg Lys Leu Asn Arg Ile Tyr Lys  
Phe Arg Gly Thr Gly Lys Ala Trp Asp Trp Glu Val Asp Thr Glu Asn Gly Asn Tyr Asp Tyr Leu  
Met Phe Ala Asp Leu Asp Met Asp His Pro Glu Val Val Thr Glu Leu Lys Asn Trp Gly Lys Trp  
Tyr Val Asn Thr Thr Asn Val Asp Gly Phe Arg Leu Asp Ala Val Lys His Ile Lys Tyr Ser Phe Phe  
Pro Asp Trp Leu Thr Tyr Val Arg Asn Gln Thr Gly Lys Asn Leu Phe Ala Val Gly Glu Phe Trp Ser  
Tyr Asp Val Asn Lys Leu His Asn Tyr Ile Thr Lys Thr Asn Gly Ser Met Ser Leu Phe Asp Ala Pro  
Leu His Asn Asn Phe Tyr Ile Ala Ser Lys Ser Ser Gly Tyr Phe Asp Met Arg Tyr Leu Leu Asn Asn  
Thr Leu Met Lys Asp Gln Pro Ser Leu Ala Val Thr Leu Val Asp Asn His Asp Thr Gln Pro Gly Gln  
Ser Leu Gln Ser Trp Val Glu Ala Trp Phe Lys Pro Leu Ala Tyr Ala Phe Ile Leu Thr Arg Gln Glu  
Gly Tyr Pro Cys Val Phe Tyr Gly Asp Tyr Tyr Gly Ile Pro Lys Tyr Asn Ile Pro Gly Leu Lys Ser  
Lys Ile Asp Pro Leu Leu Ile Ala Arg Asp Asp Tyr Ala Tyr Gly Thr Gln Arg Asp Tyr Ile Asp His  
Gln Asp Ile Ile Gly Trp Thr Arg Glu Gly Ile Asp Ala Lys Pro Asn Ser Gly Leu Ala Ala Leu Ile Thr  
Asp Gly Pro Gly Gly Ser Lys Trp Met Tyr Val Gly Lys Lys His Ala Gly Lys Val Phe Tyr Asp Leu  
Thr Gly Asn Arg Ser Asp Thr Val Thr Ile Asn Ala Asp Gly Trp Gly Glu Phe Lys Val Asn Gly Gly  
Ser Val Ser Ile Trp Val Ala Lys Thr Ser Asn Val Thr Phe Thr Val Asn Asn Ala Thr Thr Thr Ser  
Gly Gln Asn Val Tyr Val Val Gly Asn Ile Pro Glu Leu Gly Asn Ser Leu

SEQ ID NO: 135

gtgacaggcaccccgctttatacatcttccacataaaataaccatacagctttcaaatgttgaaatgtataaaaaataaaatagtttgaagc  
gttaacatccgtcattataataacttcaaacgcgtttatgtttaatgcaaacggttgcatcctcattttatttaagaaaggatgtgtgcatgaattatt  
tgaaaaaagtgtggtgtattacgctatcgtcgtacctaatacttcttctacgccctttcaactgcacaagccaacactgcaccagtcacag  
gaacgatgatgaatatttgaatgggatttaccgaatgatggcacactttggacgaaagtaaaaaacgaagcaagcagccttcttcttaggtat  
tactgcgttatggttaccactgcatacaagggaacgagccaaagggtatggcgtgtacgattttagttagtaggaatattatca  
aaaagggacgattcgaacgaaatcgaacaaaaacgcaatatttacaagccattcaagcggcggcaaaaagcgtggcatgcaagtatacgtg  
atgtcgtatttaatacagaaggcgggggcagatagtagaagtggttgacgcagtcgaagtgaatccttctaatacgaaaccaagaacatctgg



Figure 16BBB

cacatatcaaatcaagcatggacaaaatttgatttccctgaccgtgggaacacatactcaagctttaaattggcgcgtggtatcattttgacggtacg  
gattgggatgaaagtcgaaactaaatcgatttacaatttcgtggcacaggaaaagcatgggattgggaagtagacacagagaacggaac  
tatgactacttaattgttctgatttagatatggtacacctgaagtcgtgacagagctaaaaaactggggaacatggtacgtcaatacgacaaatg  
tcgatgggttctgcttagatgcagtaaagcatattaaatagcttttcccagattgggttaacatatgtgcgctcacaacacaaaaaatctgtttg  
cagtaggagaattttggagctacgatgcaataaactgcataactacattacaaaaacaagtggaaacctgtcgttatttgatgcgccacttcataa  
caacttttacactgcttcaaaatctagcgggtattttgacatgcgctatttggtaataatacgttgatgaaagaccagccttctctgcggtcacactc  
gttgataatcatgacacgcaaccgggacaatctttacaatcatgggtagagccttggttaagccgctgcttatgcctttattttgacaagacaaga  
aggataccttgctgattttacggcgactattacggcatcctaataacaatttccgggattgaaaagtaaaatcgatccgcttctcattgcccgtg  
gagactacgcatacgaacacaacgtgattatattgacctcaagacattattggatggacacgggaagggaattgactaaaaccggaactctgg  
acttgcggcttaattactgacggctcgttggaagtaaatggatgtatgtaggtaaaaagcatgctggaaggtgtttacgatctcactggaat  
cgaagcgatacggtaacgattaatgcagacggctggggagaggttaagtaaacgggtgctccgtttccatttgggttgccaaaacatcacaag  
tcacgtttaccgtcaacaatgcgacaacgacaagcggacaaaatgtgtatgtcgttggaacattccagagctcggaattggaacacagcaaa  
cgcaatcaaatgaccccatcttcttccaacgtggaaaacaaccattgtcttccacaaggaaaagcaattggcggcgtagccatggccctt  
ga

SEQ ID NO: 136

Val Thr Gly Thr Pro Ser Leu Tyr Ile Pro Pro His Lys Ile Thr Ile Gln Leu Ser Asn Leu Leu Lys Cys  
Ile Lys Ile Lys Asn Ser Ile Val Ser Val Asn Ile Arg His Tyr Asn Asn Phe Lys Arg Val Tyr Val Leu  
Met Gln Thr Phe Ala Ser Ser Phe Tyr Leu Lys Lys Gly Cys Val Cys Met Asn Tyr Leu Lys Lys Val  
Trp Leu Tyr Tyr Ala Ile Val Ala Thr Leu Ile Ile Ser Phe Leu Thr Pro Phe Ser Thr Ala Gln Ala Asn  
Thr Ala Pro Val Asn Gly Thr Met Met Gln Tyr Phe Glu Trp Asp Leu Pro Asn Asp Gly Thr Leu  
Trp Thr Lys Val Lys Asn Glu Ala Ser Ser Leu Ser Ser Leu Gly Ile Thr Ala Leu Trp Leu Pro Pro  
Ala Tyr Lys Gly Thr Ser Gln Gly Asp Val Gly Tyr Gly Val Tyr Asp Leu Tyr Asp Leu Gly Glu Phe  
Asn Gln Lys Gly Thr Ile Arg Thr Lys Tyr Gly Thr Lys Thr Gln Tyr Leu Gln Ala Ile Gln Ala Ala  
Lys Ser Ala Gly Met Gln Val Tyr Ala Asp Val Val Phe Asn His Lys Ala Gly Ala Asp Ser Thr Glu  
Trp Val Asp Ala Val Glu Val Asn Pro Ser Asn Arg Asn Gln Glu Thr Ser Gly Thr Tyr Gln Ile Gln  
Ala Trp Thr Lys Phe Asp Phe Pro Asp Arg Gly Asn Thr Tyr Ser Ser Phe Lys Trp Arg Trp Tyr His  
Phe Asp Gly Thr Asp Trp Asp Glu Ser Arg Lys Leu Asn Arg Ile Tyr Lys Phe Arg Gly Thr Gly Lys  
Ala Trp Asp Trp Glu Val Asp Thr Glu Asn Gly Asn Tyr Asp Tyr Leu Met Phe Ala Asp Leu Asp  
Met Asp His Pro Glu Val Val Thr Glu Leu Lys Asn Trp Gly Thr Trp Tyr Val Asn Thr Thr Asn Val  
Asp Gly Phe Arg Leu Asp Ala Val Lys His Ile Lys Tyr Ser Phe Phe Pro Asp Trp Leu Thr Tyr Val  
Arg Ser Gln Thr Gln Lys Asn Leu Phe Ala Val Gly Glu Phe Trp Ser Tyr Asp Val Asn Lys Leu His  
Asn Tyr Ile Thr Lys Thr Ser Gly Thr Met Ser Leu Phe Asp Ala Pro Leu His Asn Asn Phe Tyr Thr  
Ala Ser Lys Ser Ser Gly Tyr Phe Asp Met Arg Tyr Leu Leu Asn Asn Thr Leu Met Lys Asp Gln  
Pro Ser Leu Ala Val Thr Leu Val Asp Asn His Asp Thr Gln Pro Gly Gln Ser Leu Gln Ser Trp Val  
Glu Pro Trp Phe Lys Pro Leu Ala Tyr Ala Phe Ile Leu Thr Arg Gln Glu Gly Tyr Pro Cys Val Phe  
Tyr Gly Asp Tyr Tyr Gly Ile Pro Lys Tyr Asn Ile Pro Gly Leu Lys Ser Lys Ile Asp Pro Leu Leu Ile  
Ala Arg Arg Asp Tyr Ala Tyr Gly Thr Gln Arg Asp Tyr Ile Asp His Gln Asp Ile Ile Gly Trp Thr  
Arg Glu Gly Ile Asp Ser Lys Pro Asn Ser Gly Leu Ala Ala Leu Ile Thr Asp Gly Pro Gly Gly Ser  
Lys Trp Met Tyr Val Gly Lys Lys His Ala Gly Lys Val Phe Tyr Asp Leu Thr Gly Asn Arg Ser Asp  
Thr Val Thr Ile Asn Ala Asp Gly Trp Gly Phe Lys Val Asn Gly Gly Ser Val Ser Ile Trp Val  
Ala Lys Thr Ser Gln Val Thr Phe Thr Val Asn Asn Ala Thr Thr Thr Ser Gly Gln Asn Val Tyr Val  
Val Gly Asn Ile Pro Glu Leu Gly Asn Trp Asn Thr Ala Asn Ala Ile Lys Met Thr Pro Ser Ser Tyr  
Pro Thr Trp Lys Thr Thr Ile Ala Leu Pro Gln Gly Lys Ala Ile Gly Gly Val Arg His Gly Pro

SEQ ID NO: 137

gtgggacgggagcgttggcgcatcactcgaacacttccgccaaggggacatacgggtcacctctcgaactgcgtccggatcggccggcgt  
ggccggggcggtcgagcttgaagatgtccagcggggagccgccgaggatcacccggcggtactcgccaggggcggggctcag  
cttgaagcgtggcggagccgctccaggagccagacttggaggcccggtatggcggtcgaggaggaggtggccgtcggggctgt  
tctcgtactggcagacgcgggtctcgaccagcggcggtcctcaggggccgggaaccggcgggccacctcgcccgggcggttccagca



Figure 16CCC

Figure 16 (cont.)

ggggccgggtgatcgtccgctcggccgcccgtgggatcgatgggctcggccgggtgctcgtccgccacctgaagccgcgggtgctcgttgcc  
ggggatgccgtagtagatccgctcggcgagatcgaccagaccggagacggccctctggaagcgcgggtcggccggcggtgcccga  
agaagaacacctcctggcgggtgttgcggaggaaccgctcaccgatcacgtccgggaacagccggccagccagggaccgcaggcgaag  
acgtagaggctggccgcgagagtggagccgtccgaaaggtgaagccgctccaagggccgggaccatggcggcctgccggtactcccc  
ggcctcggcctggaacagctccaccaggtccggcagggcgcggcggaacagggcgccggttctctctctgtaccagatcgtgcggac  
ggcgtcgaaatcgacctgggggaagcggctccggcctccccctgagacagctcggcgaccggcagccccgcgtctccagaaaaggaa  
gggagtcgggacgtagctgtcgtcctcgccgcacatccagaggaccccggtctttgtacagccggttaaccggactggacttcggcgtccc  
gccagagctcgaaggagcggcgacccactccacgtacagacggctcgggtccgttaggcgccgggatgatccgcgtctcggaccggag  
ctggagcgggagtggccggacccagggcgtccaggaggggtacccgggctccggcgaggagatgcaggggcgtccagccggcg  
aaggcgccggcgccgacgagcgcatatggggatgggagggcatggcgggcgtaaggttatcgagcccgatccttcgtggcatccat  
ctccgaccggagtatcctggaataatcgaagaaggagatcgacatgcaatcgaacggaacgtga

SEQ ID NO: 138

Val Gly Arg Ala Gly Leu Ala His His Ser Asn Thr Ser Ala Lys Gly Thr Tyr Gly Ser Pro Leu Glu  
Leu Arg Pro Asp Arg Pro Ala Val Ala Gly Ala Val Glu Leu Glu Asp Val Gln Arg Gly Ala Ala Ala  
Glu Asp His Pro Gly Gly Val Leu Ala Gln Gly Gly Ala Gln Leu Glu Ala Val Ala Gly Ala Ala Ser  
Gln Glu Pro Asp Val Gly Gly Pro Arg Met Ala Val Glu Glu Glu Val Ala Val Gly Ala Val Leu Val  
Leu Ala Asp Ala Gly Leu Asp Gln Arg Arg Val Leu Gln Gly Arg Glu Pro Ala Gly His Leu Gly  
Pro Gly Arg Phe Gln Gln Gly Arg Gly Asp Arg Pro Leu Ala Arg Arg Gly Ile Asp Gly Leu Ala Pro  
Gly Val Val Arg His Leu Glu Ala Ala Val Leu Val Ala Gly Asp Ala Val Val Asp Pro Leu Ala Glu  
Ile Asp Pro Asp Arg Thr Ala Ala Leu Leu Glu Ala Arg Val Ala Arg Arg Arg Ala Glu Glu Glu His  
Leu Leu Ala Gly Val Ala Glu Glu Pro Leu Thr Asp His Val Arg Glu Gln Pro Gly Gln Pro Gly Thr  
Ala Gly Glu Asp Val Glu Val Gly Arg Glu Ser Gly Ala Val Arg Lys Val Lys Pro Leu Gln Gly Pro  
Arg Asp His Gly Gly Leu Pro Val Leu Pro Ala Leu Ala Leu Glu Gln Leu His His Gly Pro Ala Gly  
Ala Pro Gly Glu Gln Gly Ala Gly Phe Leu Leu Val Pro Asp Arg Ala Asp Ala Val Glu Ile Asp Leu  
Gly Glu Ala Ala Pro Gly Leu Pro Leu Arg Gln Leu Gly Asp Arg Gln Pro Arg Val Leu Gln Lys  
Arg Lys Gly Val Ala Asp Val Ala Val Val Leu Ala Ala His Pro Glu Asp Pro Gly Pro Phe Val Gln  
Pro Val Thr Gly Leu Asp Phe Gly Val Pro Pro Glu Leu Glu Gly Ala Gly Asp Pro Leu His Val Gln  
Thr Val Gly Ser Val Gly Ala Ala Asp Asp Pro Arg Leu Ala Thr Gly Ala Gly Ala Gly Val Pro Arg  
Thr Pro Gly Val Gln Glu Gly His Pro Gly Ser Ala Ala Glu Glu Met Gln Gly Gly Pro Ala Ala Glu  
Gly Ala Gly Ala Asp Asp Gly Asp Met Gly Met Gly Gly His Gly Gly Arg Lys Val Ile Ala Ala Arg  
Ser Phe Ala Gly Ile Pro Ser Pro Thr Gly Val Ser Trp Lys Ile Arg Arg Arg Arg Ser Thr Cys Asn  
Arg Thr Glu Thr

SEQ ID NO: 139

atgaaaacattcaaccttaaacccacacttttaccttaactttgctgctgagttcgccggtattggcggcacaaaatggaactatgatgcagtatcttc  
cattgggtatgtgccaatgacggcgactctggacacaagttgaaaacaatcgccagcactatccgacaacggtttacagcgctgtgtgtgc  
caccagcatataaaggcgaggtgtagcaacgacgttggttacggtttacgatatgtatgacttaggggagttgatcaaaaaggatcggtga  
cgaactaagtacggcaccaaagaccaatatctaaatgccatcaaagcagcacacaaaaacaatatccaaatttatggtgacgtagtgtcaacca  
tcgtggcggtgcagatggcaagtcgtgggtcgataccaagcgtgtggtggaataaccgcaatattgaacttggcgataaatggattgaagca  
tgggttgaatttagcttccaggacgtaacgataaatactcagacttcattggacgtggtatcactttgatggcgctgattgggatgacgcaggta  
aagagaaagcgatcttaaatcaaaaggtgatggtaaagcatgggattgggaagtcagttctgaaaaaggcaactatgactacctcatgtacgca  
gacttagacatggatcaccagaagtgaaagcaagagctgaagattgggtgaatggtacttaacatgacgggtgttgatggcttccgaatgg  
atgcagtgaacacatcaaatatcagtaacctacaagagtggatcgattacttgcgtaagaaaacgggcaagagctctttaccgttggtgagtac  
tggaaactacgacgtgaacaatctgcacaactttatgactaagacttctggcagcatgtcattgttgatgcgctttacatatgaacttataacgct  
tcacgctctggtgcaactttgatatgcgccgaatcatggtggcacttgatgaaagacaaccagtgaaagcagtaaacactggttgagaacc  
atgatacgcaaccactacagggccttagagtcctcggttgattggtgttcaaacacttgcgtacgcgttcattttgcttcgtgaggaaaggttatcc  
gtcagttcttacgcagattactacggtgcgaatacagcgataaaggcgacgatacaacatggtgaaagtgcccttacattgagcaattggtga  
aagcgcgtaagattatgcttatggtaaacaacattcttacccttgaccactgggatgtgattggttgacacgagaaggggatcggaacatccg



Figure 16DDD

aactctatggcgggtatcatgagtgatggctctggcggacaagtgatgtacacaggttcaccgagcacacgttatgtcgataaactagggtatt  
cgtaccgaagaagtatggactaacgctagtggatggcgccgaattccagtgaaacggcgatcggtttctgttgggttggcggttaataa

SEQ ID NO: 140

Met Lys Thr Phe Asn Leu Lys Pro Thr Leu Leu Pro Leu Thr Leu Leu Ser Ser Pro Val Leu Ala  
Ala Gln Asn Gly Thr Met Met Gln Tyr Phe His Trp Tyr Val Pro Asn Asp Gly Ala Leu Trp Thr Gln  
Val Glu Asn Asn Ala Pro Ala Leu Ser Asp Asn Gly Phe Thr Ala Leu Trp Leu Pro Pro Ala Tyr Lys  
Gly Ala Gly Gly Ser Asn Asp Val Gly Tyr Gly Val Tyr Asp Met Tyr Asp Leu Gly Glu Phe Asp  
Gln Lys Gly Ser Val Arg Thr Lys Tyr Gly Thr Lys Asp Gln Tyr Leu Asn Ala Ile Lys Ala Ala His  
Lys Asn Asn Ile Gln Ile Tyr Gly Asp Val Val Phe Asn His Arg Gly Gly Ala Asp Gly Lys Ser Trp  
Val Asp Thr Lys Arg Val Asp Trp Asn Asn Arg Asn Ile Glu Leu Gly Asp Lys Trp Ile Glu Ala Trp  
Val Glu Phe Ser Phe Pro Gly Arg Asn Asp Lys Tyr Ser Asp Phe His Trp Thr Trp Tyr His Phe Asp  
Gly Val Asp Trp Asp Asp Ala Gly Lys Glu Lys Ala Ile Phe Lys Phe Lys Gly Asp Gly Lys Ala Trp  
Asp Trp Glu Val Ser Ser Glu Lys Gly Asn Tyr Asp Tyr Leu Met Tyr Ala Asp Leu Asp Met Asp  
His Pro Glu Val Lys Gln Glu Leu Lys Asp Trp Gly Glu Trp Tyr Leu Asn Met Thr Gly Val Asp Gly  
Phe Arg Met Asp Ala Val Lys His Ile Lys Tyr Gln Tyr Leu Gln Glu Trp Ile Asp Tyr Leu Arg Lys  
Lys Thr Gly Lys Glu Leu Phe Thr Val Gly Glu Tyr Trp Asn Tyr Asp Val Asn Asn Leu His Asn  
Phe Met Thr Lys Thr Ser Gly Ser Met Ser Leu Phe Asp Ala Pro Leu His Met Asn Phe Tyr Asn Ala  
Ser Arg Ser Gly Gly Asn Phe Asp Met Arg Arg Ile Met Asp Gly Thr Leu Met Lys Asp Asn Pro  
Val Lys Ala Val Thr Leu Val Glu Asn His Asp Thr Gln Pro Leu Gln Ala Leu Glu Ser Pro Val Asp  
Trp Trp Phe Lys Pro Leu Ala Tyr Ala Phe Ile Leu Leu Arg Glu Glu Gly Tyr Pro Ser Val Phe Tyr  
Ala Asp Tyr Tyr Gly Ala Gln Tyr Ser Asp Lys Gly His Asp Ile Asn Met Val Lys Val Pro Tyr Ile  
Glu Gln Leu Val Lys Ala Arg Lys Asp Tyr Ala Tyr Gly Lys Gln His Ser Tyr Leu Asp His Trp Asp  
Val Ile Gly Trp Thr Arg Glu Gly Asp Ala Glu His Pro Asn Ser Met Ala Val Ile Met Ser Asp Gly  
Pro Gly Gly Thr Lys Trp Met Tyr Thr Gly Ser Pro Ser Thr Arg Tyr Val Asp Lys Leu Gly Ile Arg  
Thr Glu Glu Val Trp Thr Asn Ala Ser Gly Trp Ala Glu Phe Pro Val Asn Gly Gly Ser Val Ser Val  
Trp Val Gly Val Lys

SEQ ID NO: 141

atgaaccaataaataccctactcatatccgcccttgctgtttgtcttccagttccgcgacttacgccgatactatttgcacgcgttcaattggaagt  
atcagatgtgacggccaacgcgaatcaaatgctcaagctgggtataagaagtgcgttgcgcctgcaatgaaatcagattggcagccaatgg  
tgggctcgtatcaacctcaagatctacgcactatcgatttcccttgggcaataaacaagatttagccgcaatgattgccgactcaaaggtgtg  
ggcgtcgatgtgtatgccgatgtgtactcaaccatattggcgaatgaaagctggaagcgaagtgaattaccctggcacagaagtgtctaa  
acgattatgtagccgttcaagctactatgctgaccagactctgttggcaacctagcacaaggttatgtgcagcgaacgacttccatccagcgg  
gctgtatttcagattggaacgacctgggtcatgttcagatttggcgttggcgcagatggatgtaggttacctgacctgatccaaacaac  
tgggtggttcacaacagcgtttgtatctgaaagcgtaaaagatatgggcatcaaaaggttccgaattgatgcagtgaagcacatgagccaata  
ccaaatcgtacaggtattcacgtctgaaattactgcgaacatgcattgttgggtgaagtgattactagcgggtggagcaggggaatagcggctatg  
aatggttctagcgccttacctgaataatactaatcactctgcctacgatttccgcgttggcatcgattcgtcggcattttctatggggggcgttt  
aaatcaactgcattgatcctaaagcgtacggtcaggcacttgatgataatcgctcgatcaccttgcgatcacacatgatattccaaccaatgacgg  
cttccgctaccaaaattatggaccacaagacgagcagcttgcttacgcgtatattccttgtaaaagacgggtggcacgccgctgatctacagtatg  
atcttctgattctgaagacaaggataacggctgttgggcaatgttggaaacagttcgacaatgaaaacatgttgagcttccataacgcgatgc  
aaggcaaaacatgacgatgatttctagcgaccattgcacttgggttaagcgtggcgaagaaggtgttgggtattacaagtggtggtgaaa  
cgcggtggcgtgacgggtgatccatcaacatgagtttaattggcatgttaatacaaaagacgtgtaagcagcgcgaacagaaaccgtgactct  
cgttaccatagcttaattaccaccacgcagtgccggtatgttaagctgtag

SEQ ID NO: 142

Met Lys Pro Ile Asn Thr Leu Leu Ile Ser Ala Leu Ala Val Cys Ser Phe Ser Ser Ala Thr Tyr Ala  
Asp Thr Ile Leu His Ala Phe Asn Trp Lys Tyr Ser Asp Val Thr Ala Asn Ala Asn Gln Ile Ala Gln  
Ala Gly Tyr Lys Lys Val Leu Val Ala Pro Ala Met Lys Ser Ser Gly Ser Gln Trp Trp Ala Arg Tyr  
Gln Pro Gln Asp Leu Arg Thr Ile Asp Ser Pro Leu Gly Asn Lys Gln Asp Leu Ala Ala Met Ile Ala

Figure 16EEE



Ala Leu Lys Gly Val Gly Val Asp Val Tyr Ala Asp Val Val Leu Asn His Met Ala Asn Glu Ser Trp  
Lys Arg Ser Asp Leu Asn Tyr Pro Gly Thr Glu Val Leu Asn Asp Tyr Ala Ser Arg Ser Ser Tyr Tyr  
Ala Asp Gln Thr Leu Phe Gly Asn Leu Ala Gln Gly Tyr Val Ser Ala Asn Asp Phe His Pro Ala Gly  
Cys Ile Ser Asp Trp Asn Asp Pro Gly His Val Gln Tyr Trp Arg Leu Cys Gly Ala Asp Gly Asp Val  
Gly Leu Pro Asp Leu Asp Pro Asn Asn Trp Val Val Ser Gln Gln Arg Leu Tyr Leu Lys Ala Leu  
Lys Asp Met Gly Ile Lys Gly Phe Arg Ile Asp Ala Val Lys His Met Ser Gln Tyr Gln Ile Asp Gln  
Val Phe Thr Ser Glu Ile Thr Ala Asn Met His Val Phe Gly Glu Val Ile Thr Ser Gly Gly Ala Gly  
Asn Ser Gly Tyr Glu Ser Phe Leu Ala Pro Tyr Leu Asn Asn Thr Asn His Ser Ala Tyr Asp Phe Pro  
Leu Phe Ala Ser Ile Arg Ser Ala Phe Ser Met Gly Gly Gly Leu Asn Gln Leu His Asp Pro Lys Ala  
Tyr Gly Gln Ala Leu Asp Asp Asn Arg Ser Ile Thr Phe Ala Ile Thr His Asp Ile Pro Thr Asn Asp  
Gly Phe Arg Tyr Gln Ile Met Asp Pro Gln Asp Glu Gln Leu Ala Tyr Ala Tyr Ile Leu Gly Lys Asp  
Gly Gly Thr Pro Leu Ile Tyr Ser Asp Asp Leu Pro Asp Ser Glu Asp Lys Asp Asn Gly Arg Trp Gly  
Asn Val Trp Asn Ser Ser Thr Met Lys Asn Met Leu Ser Phe His Asn Ala Met Gln Gly Lys Thr  
Met Thr Met Ile Ser Ser Asp His Cys Thr Leu Leu Phe Lys Arg Gly Lys Glu Gly Val Val Gly Ile  
Asn Lys Cys Gly Glu Thr Arg Gly Val Thr Val Asp Thr Tyr Gln His Glu Phe Asn Trp His Val Gln  
Tyr Lys Asp Val Leu Ser Ser Ala Thr Glu Thr Val Thr Ser Arg Tyr His Thr Phe Asn Leu Pro Pro  
Arg Ser Ala Arg Met Phe Lys Leu

SEQ ID NO: 143

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SEQ ID NO: 144

Met Pro Lys Ser Thr Phe Thr Lys Ser Ile Thr Lys Ser Leu Leu Ala Thr Ser Val Val Val Ser Leu  
Leu Pro Ala Tyr Ala Gln Ala Asp Thr Ile Leu His Ala Phe Asn Trp Lys Tyr Ser Asp Ile Thr Arg  
Gln Ala Glu Gln Ile Ala Gln Ala Gly Tyr Lys Lys Val Leu Ile Ser Pro Leu Lys Ser Thr Gly Pro  
Gln Trp Trp Ala Arg Tyr Gln Pro Gln Pro Gln Asp Ile Arg Val Ile Asp Ser Pro Val Gly Asn Lys Gln Asp  
Leu Gln Ala Leu Ile Ala Ala Leu Lys Ala Gln Gly Val Glu Val Tyr Ala Asp Ile Val Leu Asn His  
Met Ala Asn Glu Ser Trp Lys Arg Asp Asp Leu Asn Tyr Pro Gly Ser Asp Leu Leu Thr Gln Tyr Ser  
Gln Asn Met Ala Tyr Met Asn Gln Gln Lys Leu Phe Gly Asp Leu Glu Gln Asn Gln Phe Ser Ala  
Asn Asp Phe His Pro Ala Gly Cys Ile Thr Asp Trp Ser Asn Pro Gly His Val Gln Tyr Trp Arg Leu  
Cys Gly Gly Asn Gly Asp Thr Gly Leu Pro Asp Leu Asp Pro Asn Ser Trp Val Ile Asp Gln Gln Lys  
Arg Tyr Leu Arg Ala Leu Lys Asp Met Gly Ile Lys Gly Phe Arg Val Asp Ala Val Lys His Met Ser  
Asp Tyr Gln Ile Asn Gln Val Phe Thr Pro Asp Ile Ile Ala Gly Leu His Val Phe Gly Glu Val Ile Thr  
Ser Gly Gly Lys Gly Ser Asn Asp Tyr His Ser Phe Leu Glu Pro Tyr Leu Asn Asn Thr Asn His Ala  
Ala Tyr Asp Phe Pro Leu Phe Ala Ser Ile Arg Asn Ala Phe Ser Tyr His Gly Ser Leu Ser Gln Leu  
His Asp Pro Gln Ala Tyr Gly Gln Ala Leu Pro Asn Asp Arg Ala Ile Thr Phe Thr Ile Thr His Asp

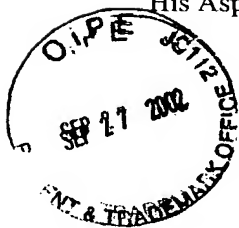


Figure 16FFF

Ile Pro Thr Asn Asp Gly Phe Arg Tyr Gln Ile Met Asp Pro Thr Ser Glu Lys Leu Ala Tyr Ala Tyr  
Ile Leu Gly Lys Asp Gly Gly Ser Pro Leu Ile Tyr Ser Asp Ala Leu Asp Pro Ser Glu Asp Lys Asp  
Lys Gly Arg Trp Arg Asp Val Trp Asn Gln Glu Tyr Met Val Asn Met Ile Ser Phe His Asn Lys Val  
Gln Gly Lys Ser Met Glu Val Met Tyr Ser Asp Gln Cys Leu Leu Val Phe Lys Arg Glu Lys Gln  
Gly Leu Val Gly Ile Asn Lys Cys Ala Glu Ser Arg Thr Tyr Thr Ile Asp Thr His Arg Phe Glu Phe  
Asn Trp Tyr Gln Pro Tyr Asn Asp Thr Leu Ser Gln His Ser Glu Thr Phe Ser Ser Arg Tyr His Ala  
Leu Thr Ile Pro Ala Gln Thr Ala Arg Met Leu Ala Leu

SEQ ID NO: 145

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SEQ ID NO: 146

Met Leu Lys Arg Ile Thr Val Val Cys Leu Leu Phe Ile Leu Leu Phe Pro Asn Ile Tyr Gly Arg Asn  
Lys Ala Glu Ala Ala Thr Ile Asn Asn Gly Thr Leu Met Gln Tyr Phe Glu Trp Tyr Ala Pro Asn Asp  
Gly Asn His Trp Asn Arg Leu Arg Tyr Asp Ala Glu Ser Leu Ala His Lys Gly Ile Thr Ser Val Trp  
Ile Pro Pro Ala Tyr Lys Gly Thr Ser Gln Asn Asp Val Gly Tyr Gly Ala Tyr Asp Leu Tyr Asp Leu  
Gly Glu Phe Asn Gln Lys Gly Thr Val Arg Thr Lys Tyr Gly Thr Lys Ala Gln Leu Lys Ser Ala Ile  
Asp Ala Leu His Lys Gln Asn Ile Asp Val Tyr Gly Asp Val Val Met Asn His Lys Gly Gly Ala Asp  
Tyr Thr Gly Thr Val Thr Ala Val Glu Val Asp Arg Asn Asn Arg Asn Ile Glu Val Ser Gly Asp Tyr  
Glu Ile Ser Ala Trp Thr Gly Phe Asn Phe Pro Gly Arg Arg Asn Asp Ala Tyr Ser Asn Phe Lys Trp Lys  
Trp Tyr His Phe Asp Gly Thr Asp Trp Asp Gly Gly Arg Lys Leu Asn Arg Ile Tyr Lys Phe Arg Gly  
Ile Gly Lys Ala Trp Asp Trp Glu Val Ser Ser Glu Asn Gly Asn Tyr Asp Tyr Leu Met Tyr Ala Asp  
Leu Asp Phe Asp His Pro Asp Val Ala Asn Glu Met Lys Ser Trp Gly Thr Trp Tyr Ala Asn Glu Leu  
Asn Leu Asp Gly Phe Arg Leu Asp Ala Val Lys His Ile Asp His Glu Tyr Leu Arg Asp Trp Val Asn  
His Val Arg Gln Gln Thr Gly Lys Glu Met Phe Thr Val Ala Glu Tyr Trp Gln Asn Asp Ile Gln Thr  
Leu Asn Asn Tyr Leu Ala Lys Val Asn Tyr Asn Gln Ser Val Phe Asp Ala Pro Leu His Tyr Asn  
Phe His Tyr Ala Ser Thr Gly Asn Gly Asn Tyr Asp Met Arg Asn Ile Leu Asn Gly Thr Val Met Lys  
Asn His Pro Ala Leu Ala Val Thr Leu Val Glu Asn His Asp Ser Gln Pro Gly Gln Ser Leu Glu Ser  
Val Val Ser Pro Trp Phe Lys Pro Leu Ala Tyr Ala Phe Ile Leu Thr Arg Ala Glu Gly Tyr Pro Ser  
Val Phe Tyr Gly Asp Tyr Tyr Gly Thr Ser Gly Asn Ser Ser Tyr Glu Ile Pro Ala Leu Lys Asp Lys  
Ile Asp Pro Ile Leu Thr Ala Arg Lys Asn Phe Ala Tyr Gly Thr Gln Arg Asp Tyr Leu Asp His Pro  
Asp Val Ile Gly Trp Thr Arg Glu Gly Asp Ser Val His Ala Lys Ser Gly Leu Ala Ala Leu Ile Ser  
Asp Gly Pro Gly Gly Ser Lys Trp Met Asp Val Gly Lys Asn Asn Ala Gly Glu Val Trp Tyr Asp Ile  
Thr Gly Asn Gln Thr Asn Thr Val Thr Ile Asn Lys Asp Gly Ser Gly Gln Phe His Val Ser Gly Gly  
Ser Val Ser Ile Tyr Val Gln Gln

Figure 16GGG



SEQ ID NO: 147

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SEQ ID NO: 148

Met Ser Leu Asn Asn Phe Lys Val Lys Leu Leu Ser Phe Ala Val Ser Ser Ala Val Leu Ser Leu Ala  
Pro Asn Leu Ala Asn Ala Ala Asn Phe Glu Ser Glu Met Val Ile Ile His Pro Phe Gln Trp Thr Tyr  
Asp Asn Ile Ala Lys Glu Cys Thr Glu Tyr Leu Gly Pro Ala Gly Phe Asp Gly Val Gln Ile Ser Gln  
Pro Ala Glu His Lys Arg Ala Glu Gly Val Trp Trp Ala Val Tyr Gln Pro Val Asn Tyr Lys Asn Phe  
Thr Thr Met Thr Gly Asn Glu Glu Gln Leu Lys Ala Met Ile Lys Thr Cys Asn Asp Ala Gly Val Lys  
Val Phe Ala Asp Ala Val Phe Asn Gln Lys Ala Thr Asp Gly Val Gly Trp Gly Gly Ser Thr Trp Ser  
Tyr Lys Asn Tyr Pro Asp Gly Phe Ser Gly Ser Asp Phe His Gly Asp Cys Ser Ile Asp Lys Ser Tyr  
Thr Asp Ala Asn Asn Val Arg Thr Cys Ala Leu Ser Gly Met Pro Asp Val Ala Thr Asp Asn Ser Ala  
Thr Gln Glu Lys Ile Ala Asp Tyr Leu Ala Ser Leu Met Asn Met Gly Val Tyr Gly Phe Arg Ile Asp  
Ala Ala Lys His Met Gly Tyr Asn Asp Ile Asn Ser Ile Leu Ser Lys Thr Ala Gln Lys Thr Gly Arg  
Arg Pro Pro Ala Tyr Leu Glu Val Ile Gly Ala Gly Asn Glu Ala Ala Asp Ile Gln Pro Asp Lys Tyr  
Thr Phe Ile Glu Asn Ala Val Val Thr Asp Phe Gly Tyr Val Trp Asp Ala Asn Glu Ser Phe Gly Lys  
Gly Asn Tyr Gly Lys Ala Leu Glu Leu Ser Thr Trp Leu Gly Ala Asn Ser Glu Thr Phe Val Asn Asn  
His Asp Asp Glu Trp Gly Arg Cys Ser Ala Gly Ser Cys Ser Met Lys Thr Gln Asn Tyr Ala Asp Tyr  
Asn Leu Ala Gln Ser Trp Leu Ala Val Trp Pro Val Gly Thr Val Arg Gln Ile Tyr Ser Gly Tyr Ser  
Phe Pro Val Lys Asp Asn Asp Pro Tyr Arg Val Ser Asp Ala Thr His Asp Gln Gly Gly Pro Leu Gly  
Ala Asp Arg Cys Glu Gly Gly Trp Leu Cys Gln His Arg Val Ser Phe Val Leu Asn Ser Pro Arg Phe  
Ala Arg Ala Thr Arg Gly Thr Ala Val Ser Thr Lys Gly Phe Asp Asn Gly Ala Leu Trp Phe Asn Arg  
Gly Ser Lys Gly Phe Tyr Ala Gln Asn Thr Thr Asn Ser Pro Ile Thr Gln Thr Phe Ser Val Glu Val  
Pro Asp Gly Asn Tyr Cys Asp Ile Leu Gly Thr Ser Asp Pro Lys Ser Asn Pro Cys Gly Ala Asp Val  
Val Val Ser Gly Gly Lys Ala Thr Phe Thr Ile Pro Ala Lys Thr Ala Val Ala Ile Cys Thr Asp Ser



Figure 16HHH

Asp Trp Cys Gly Lys Gly Val Asp Pro Cys Glu Ser Asp Pro Thr Gly Ala Ala Cys Val Cys Lys Gly  
Glu Thr Thr Val Asn Gly Val Cys Val Ser Trp Cys Asn Ala His Ser Ser Asn Glu Glu Cys Thr Cys  
Val Leu Asn Pro Asn Asp Ala Asn Cys Gln Ala Asp Ile Glu Pro Thr Lys Gly Lys Leu Cys Tyr Ala  
Gly Thr Ser Asn Gly Trp Lys Gln Asp Pro Leu Thr Tyr Asn Arg Lys Thr Gly Phe Trp Thr Ile Asn  
Leu Thr Leu Asp Gly Ala Gly Asp Thr Ser Gly Ala Gln Arg Phe Lys Val Thr Asp Gly Cys Ser Trp  
Thr Gly Thr Val Tyr Gly Ser Ser Gly Thr Ala Gly Lys Leu Asp Val Asn Thr Ser Ser Thr Gly Asp  
Glu Pro Val Ser Leu Val Gly Asp Tyr Val Leu Ser Ile Asn Asp Lys Thr Met Glu Tyr Thr Phe Thr  
Lys Ala Asp Glu Val Thr Asn Gln Pro Pro Val Ala Ser Phe Thr Ala Thr Val Asn Gly Leu Thr Val  
Ser Phe Ala Asn Asn Ser Ser Asp Pro Glu Asn Asp Glu Leu Thr Tyr Ser Trp Asn Phe Gly Asn Gly  
Lys Thr Ser Ser Glu Lys Ala Pro Ser Ile Thr Tyr Glu Glu Ser Gly Lys Tyr Thr Val Thr Leu Lys  
Val Thr Asp Ser Ala Asn Asn Thr Asp Thr Phe Thr Lys Asp Ile Thr Val Thr Ala Pro Ser Ser Gly  
Lys Tyr Leu Lys Val Ala Val Arg Gly Ser His Asp Asn Tyr Gly Thr Asp Leu Leu Thr Lys Asn Gly  
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SEQ ID NO: 149

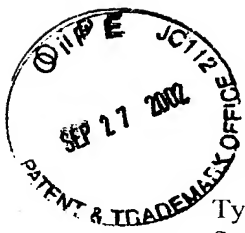
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SEQ ID NO: 150

Met Ile Leu Ser Asn Phe Lys Val Lys Leu Leu Ser Phe Ala Val Ser Ser Ala Val Leu Thr Leu Ala  
Ala Asn Val Ala Asn Ala Lys Asn Tyr Glu Ser Glu Met Val Ile Ile His Pro Phe Gln Trp Thr Tyr  
Asp Asn Ile Ala Lys Glu Cys Thr Glu Tyr Leu Gly Pro Ala Gly Phe Asp Gly Val Gln Ile Ser Gln  
Ala Ala Glu His Lys Asp Ala Gly Gly Ala Trp Trp Gly Thr Tyr Gln Pro Val Asn Phe Lys Ser Phe  
Thr Thr Met Val Gly Asn Glu Glu Gln Leu Arg Ala Met Ile Lys Thr Cys Asn Glu Ala Gly Val Lys  
Val Phe Ala Asp Ala Val Ile Asn Gln Lys Ala Gly Asp Gly Val Gly Ile Gly Gly Ser Thr Phe Gly  
Asn Tyr Asn Tyr Pro Asp Gly Phe Thr Ser Asp Asp Phe His His Asn Asn Cys Ser Ile Gly Asn Asn



Figure 16III



Tyr Ser Asp Ala Trp Val Val Arg Phe Cys Asp Leu Ser Gly Met Pro Asp Ile Ala Thr Asp Asn Asp  
Ser Thr Arg Asn Lys Ile Ala Asp Tyr Phe Ala Ser Leu Met Asn Met Gly Val Tyr Gly Phe Arg Ile  
Asp Ala Ala Lys His Phe Ser Tyr Asp Asp Ile Asp Ala Ile Val Glu Lys Thr Ala Thr Lys Ala Gly  
Arg Arg Pro Pro Val Tyr Met Glu Val Ile Gly Asn Pro Gly Gln Glu Ala Asp Asp Ile Gln Pro Asn  
Lys Tyr Thr Trp Ile Asp Asn Ala Val Val Thr Asp Phe Thr Tyr Ala Asn Ser Met His Asn Ile Phe  
Asn Gly Ser Gly Tyr Ala Lys Ala Leu Asn Met Gly Leu Gly His Val Asp Ala Glu Asn Ala Glu Val  
Phe Ile Ser Asn His Asp Asn Glu Trp Gly Arg Lys Ser Ala Gly Ser Cys Ser Ile Arg Thr Gln Asn  
Asn Pro Asp Tyr His Leu Ala Gln Ser Trp Leu Ala Val Trp Pro Leu Gly Lys Val Arg Gln Ile Tyr  
Ser Ala Tyr Gln Phe Pro Val Phe Glu Asp Ser Cys Glu Arg Val Ser Gln Gln Ala His Asp Gln Gly  
Gly Pro Ile Gly Ala Ala Arg Cys Glu Gly Gly Trp Leu Cys Gln His Arg Val Pro Phe Val Leu Asn  
Ser Pro Arg Phe Ala Arg Ala Thr Arg Gly Thr Val Val Thr Thr Lys Gly Phe Asp Asp Gly Ala Leu  
Trp Phe Asn Arg Gly Ser Lys Gly Phe Tyr Ala Gln Asn Thr Thr Gly Ser Ser Ile Thr His Thr Phe  
Ser Val Glu Leu Pro Asp Gly Asn Tyr Cys Asp Ile Leu Gly Ala Thr Asp Pro Lys Asn Asn Pro Cys  
Gly Ala Asp Val Thr Val Ser Gly Gly Lys Ala Thr Phe Thr Ile Pro Ala Lys Thr Ala Val Ala Ile  
Cys Thr Asp Glu Lys Trp Cys Gly Lys Gly Val Asp Pro Cys Glu Ser Asp Pro Thr Gly Ser Ala Cys  
Val Cys Lys Gly Glu Thr Thr Val Asn Gly Val Cys Val Ser Trp Cys Asn Ala His Ser Ser Asn Glu  
Glu Cys Ala Cys Val Leu Asn Pro Asn Asp Ala Glu Cys Gln Ala Asp Ile Glu Pro Thr Lys Gly Lys  
Leu Cys Tyr Val Gly Thr Ser Asn Lys Trp Thr Gln Glu Pro Leu Thr Tyr Asn Arg Lys Thr Gly Phe  
Trp Thr Leu Asn Val Glu Leu Asp Gly Lys Gly Asp Thr Ser Gly Ala Gln Arg Phe Lys Val Thr  
Asp Gly Cys Ser Trp Gln Gly Thr Val Tyr Gly Ser Ser Gly Val Glu Gly Arg Leu Asp Val Asn Thr  
Ser Ala Thr Gly Asp Glu Pro Val Ser Leu Thr Gly Lys Tyr Val Leu Ser Ile Asn Asp Lys Thr Met  
Glu Tyr Thr Phe Ile Pro Ala Gly Ser Gly Asn Lys Pro Pro Val Ala Ser Phe Thr Pro Thr Val Lys  
Asp Leu Thr Val Ser Phe Val Asn Asn Ser Ser Asp Pro Glu Asn Asp Glu Leu Thr Tyr Ser Trp Asn  
Phe Gly Asn Gly Lys Thr Ser Ser Glu Lys Asn Pro Ser Val Thr Tyr Asp Lys Ala Gly Lys Tyr Thr  
Val Ser Leu Lys Val Thr Asp Thr Ala Asn Asn Thr Asp Thr Lys Thr Leu Glu Ile Asp Leu Thr Ser  
Pro Val Asn Gly Lys Tyr Ser Lys Val Ala Val Arg Gly Ser His Asp Asn Tyr Gly Thr Asn Leu Leu  
Thr Arg Asn Gly Ser Glu Trp Thr Gly Ile Phe Glu Phe Ser Lys Thr Thr Lys Phe Lys Leu Glu Ala  
Leu Pro Pro Ala Ala Asp Gln Cys Ile Phe Leu Gly Gly Asn Arg Gly Glu Ala Leu Thr Ala Ser Gly  
Gly Phe Ile Ser Leu Pro Ala Gly Arg Tyr Thr Ile Lys Phe Asn Glu Glu Ser Lys Val Leu Thr Ala  
Gly Asp Val Asp Cys Thr Gly

SEQ ID NO: 151

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agcagctacggctgttcacgtacctaacaagcagaaggaactggcatcatagccgatgtagtgtcaatcaccgaaagaatgtctaaactg  
ggtggatttccggccgagacctacaacgggtgaacctatcagatggtaagcaccgacatcgttcgaacgatgacggcggaaaaacagcca  
cttgggcaaatcaaaacggctacgtctctctccaatgccgacgaaggcgaaggctgggacggcatgcgcgacctggaccacaagtcgca  
gaacgtgcagaaatcggttcttgctacaccaaatactggttgacgacttaggctataccggattccgctacgatattgtaaaagggtttgacgg  
atcgcatgtagccgactacaacaccaatgccggcgtgcagttctctgctggcgaatttgggacggcactgcatcgaaagtgttacagttggatca  
acagcaccaaaaagagcgatgtgccgcagtcggcagccttcgacttcgcttccgatacacctgccgcgatgccgtcaacaacaagaactgg  
gcgaacctgaagaacacttccggatcagcgatgccgattacaggcgctattcgggtacgtttgttgaaatcacgatacggaaatcaggttcagct  
acggcttcccaggatcccatcaagggtgatacgggtgcccctcaatgcctggatgtcggctatgccgggcacacctgtgtttctcgaacattgg  
accgactgcaagggaagagatcaagaatctcatcgaggcacgtcgcttggtcgttattacaaccagagcacctatgccgaatggatgagcgg  
tgacgcctacatcggacgtaccgtaacaggtacgaacggcaccttacgtgttctgtcggctcttatcagtataatgtagccgccaactacattca  
gattctcagggcaaaaaactataaatactacgtactcaacacgctcgaggctccctggatcgggaaagggtccggctcgtacaccgaagggtgaa  
accgtaacgggttcgctcatcgccatcggccgatgccaatgccaaagctggtatataccaccgacggcacagaccccacgcgaaccca  
ggcgaacaggcggaactgaccatcctcggacgcgcgtctgaagggttggtctgcttccggcggcatcgtcagggaacacacagagc  
cgtaactcaccttcagggtgcaaacacctccgagttaccacagccacatgcacgtatgcaaccagtcggagctctcaatccgctgtttgc  
ctatgtttgggcaggaccggacaacgagcagattaacggcaactggccgggacccaagctcaccgctaccattaccgaaacaaccttacct

Figure 16JJJ



ggtagacacgcagtcgttccgattccgaagaacgtggactatgtcgtgaactttgtttaccacaaaccggcggtacgcagacagtggatgtt  
accggcatgaaggccgatgtctgttacattattaacagtaccaagagcggaacaagtagcacggtaaccgacgttacctcacagtattcttcgtt  
agaggccatctttgatgaagaaaactccggctccttccctgtctatgacctgcaggagcggcgctcagcgaaattagaacaggacaattatat  
cttcagaacggaaagaagatactatcagataaacagagggttccgaaccattctcctattatgaaatcagacacttagtaatctcagcactgctg  
ggtttggggggctgttacaccatcagctgctcctcgtcggg

SEQ ID NO: 152

Met Lys Thr Ile Leu Ser Thr Ile Met Val Met Ala Ala Ala Ala Thr Thr Val Glu Ala Gln Gly  
Trp Pro Glu Asn Tyr Gly Gly Val Met Leu Gln Gly Phe Tyr Trp Asp Ser Tyr Ser Ala Thr Lys Trp  
Thr Lys Leu Glu Ala Gln Ala Asp Glu Ile Cys Asn Tyr Phe Ser Leu Val Trp Val Pro Gln Ser Ala  
Tyr Thr Gly Ser Ser Thr Ser Met Gly Tyr Asp Pro Leu Tyr Tyr Phe Asp Gln His Ser Ser Phe Gly  
Thr Glu Glu Gln Leu Arg Ser Phe Ile Ser Thr Tyr Lys Gln Lys Gly Thr Gly Ile Ile Ala Asp Val Val  
Val Asn His Arg Lys Asn Val Ser Asn Trp Val Asp Phe Pro Ala Glu Thr Tyr Asn Gly Val Thr Tyr  
Gln Met Val Ser Thr Asp Ile Val Ser Asn Asp Asp Gly Gly Lys Thr Ala Thr Trp Ala Asn Gln Asn  
Gly Tyr Ser Leu Ser Ser Asn Ala Asp Glu Gly Glu Gly Trp Asp Gly Met Arg Asp Leu Asp His  
Lys Ser Gln Asn Val Gln Lys Ser Val Leu Ala Tyr Thr Lys Tyr Leu Val Asp Asp Leu Gly Tyr Thr  
Gly Phe Arg Tyr Asp Met Val Lys Gly Phe Asp Gly Ser His Val Ala Asp Tyr Asn Thr Asn Ala  
Gly Val Gln Phe Ser Val Gly Glu Tyr Trp Asp Gly Thr Ala Ser Lys Val Tyr Ser Trp Ile Asn Ser  
Thr Lys Lys Ser Asp Val Pro Gln Ser Ala Ala Phe Asp Phe Ala Phe Arg Tyr Thr Cys Arg Asp Ala  
Val Asn Asn Lys Asn Trp Ala Asn Leu Lys Asn Thr Ser Gly Ile Ser Asp Ala Asp Tyr Arg Arg Tyr  
Ser Val Thr Phe Val Glu Asn His Asp Thr Glu Tyr Arg Ser Ala Thr Ala Ser Gln Asp Pro Ile Lys  
Gly Asp Thr Val Ala Leu Asn Ala Trp Met Leu Ala Met Pro Gly Thr Pro Cys Val Phe Leu Lys His  
Trp Thr Asp Cys Lys Glu Glu Ile Lys Asn Leu Ile Glu Ala Arg Arg Leu Val Gly Ile His Asn Gln  
Ser Thr Tyr Ala Glu Trp Met Ser Gly Ala Ala Tyr Ile Gly Arg Thr Val Thr Gly Thr Asn Gly Thr  
Leu Arg Val Leu Cys Gly Ser Tyr Gln Tyr Asn Val Ala Ala Asn Tyr Ile Gln Ile Leu Ser Gly Lys  
Asn Tyr Lys Tyr Tyr Val Leu Asn Thr Leu Glu Ala Pro Trp Ile Gly Lys Gly Ser Gly Ser Tyr Thr  
Glu Gly Glu Thr Val Thr Val Pro Leu Ile Ala Ile Ser Ala Asp Ala Asn Ala Lys Leu Val Tyr Thr  
Thr Asp Gly Thr Asp Pro Thr Ala Thr Ser Thr Ala Val Thr Ser Gly Thr Glu Leu Thr Ile Thr Ser  
Asp Ala Val Leu Lys Val Gly Leu Leu Ser Gly Gly Ile Val Arg Asn Ile Gln Ser Arg Thr Phe Thr  
Phe Gln Ala Ala Asn Thr Ser Glu Tyr Tyr Thr Ala Thr Met His Val Cys Asn Gln Ser Gly Ala Leu  
Asn Pro Leu Phe Ala Tyr Val Trp Ala Gly Pro Asp Asn Glu Gln Ile Asn Gly Asn Trp Pro Gly Thr  
Lys Leu Thr Ala Thr Ile Thr Glu Asn Asn Leu Thr Trp Tyr Thr Gln Ser Phe Gln Ile Pro Lys Asn  
Val Asp Tyr Val Val Asn Phe Val Phe Thr Thr Thr Gly Gly Gly Thr Gln Thr Val Asp Val Thr Gly  
Met Lys Ala Asp Val Trp Tyr Ile Ile Asn Ser Thr Lys Ser Gly Asn Lys Tyr Thr Val Thr Asp Val  
Thr Ser Gln Tyr Ser Ser Leu Glu Ala Ile Phe Asp Glu Glu Asn Ser Gly Ser Phe Pro Val Tyr Asp  
Leu Gln Gly Arg Arg Val Ser Glu Ile Arg Asn Arg Thr Ile Ile Ser Ser Glu Arg Lys Glu Asp Thr  
His Gln Ile Asn Arg Gly Ser Glu Pro Phe Ser Tyr Tyr Glu Asn Gln Thr Leu Ser Asn Leu Ser Thr  
Ala Gly Phe Gly Gly Leu Val His His Gln Leu Leu Leu Val Gly

SEQ ID NO: 69

atgttgaaggattacggtagtctgtttattgtttatttgccttttccataatatatagaggaaataaggcagaagcagcaacagtgaacaatgga  
acattaatgcagtatgttgagtggtacgctccgaatgatgggaatcattggaatcgtttgcgtccgatgctgaaagttagctcataaaggaaatcac  
atctgtatggataccacctgcataaaagggaacttcgcaaaatgatgtagggtatggggcctatgatttatatgatttaggggagttcaatcaaaaa  
ggaacgggtgcggacgaaatatgggacaaaagcacagttgaaatctgcaattgacgcttacataagcaaaacatcgacgtatacgggtgatgtag  
ttatgaatcataaagggtggggctgattatactgaaaccgtgtaacagctgttgaggtagaccgtaacaatcgaaatattgaagtacaggtgattatca  
aattagtgcacgggggtttaatttccaggggcggagatgcttatttcaatttcaaatggaaatgggtatcattttgacggaacggattgggatg  
aagggaaggaaataaatacgaattataaaatttaggggttagataaagcgtgggattgggaagtgtctagcgaaatggaaattatgattattgat  
gtatgcagatcttgattttgatcatcctgatgttgcgaatgagatgaaaaattggggaacatggatgcaatgaattaaattagatggcttctgtt  
ggacgctgttaaacatattgatcatgaataattacgcgattgggtaaatcatgccagacagcaaacggggaagaaatgtttacagttagctgaata  
ttggcaaatgatgttcaggctttaacaattatttagcgaaagtcaattataatcaatctgttttgatgcaccgcttcattacaatttccattatgcttc

Figure 16KKK

aacaggaaatgggaattatgatatgagaaa\*attttaaatggaacagtaatgaaaaatcaccctgcactcgcagtactctcgttgagaatcatgat  
tctcagcctgggcagtcattggaatctgtagtaagtccgtggttaagccgctggcatatgcatttttaactcgtgcagagggctatccttcagtt  
ttctatggtgattactatgggacaagcggaaatagtagttatgaaattccagcgttaaaagataaaattgatccaattttgacggcacgaaaaaactt  
tgcataatggtacgcagcgtgattatttagaccatccagatgtgattggctggacaagagaaggcgatgggtgtacatgctaattctggtttagcgac  
attactctcggacggaccaggagatcaaagtggatggatgttgaaagaataacgctggggaagtatgtgtacgatattacgggtaatacaaac  
aaatactgtaacaattaataaggacggatgggggcagttctatgtaagtggcggtcagtttccatatatgttcagcggttaa

SEQ ID NO: 70

Met Leu Lys Arg Ile Thr Val Val Cys Leu Leu Phe Ile Leu Leu Phe Pro Asn Ile Tyr Glu Gly Asn  
Lys Ala Glu Ala Ala Thr Val Asn Asn Gly Thr Leu Met Gln Tyr Phe Glu Trp Tyr Ala Pro Asn Asp  
Gly Asn His Trp Asn Arg Leu Arg Ser Asp Ala Glu Ser Leu Ala His Lys Gly Ile Thr Ser Val Trp  
Ile Pro Pro Ala Tyr Lys Gly Thr Ser Gln Asn Asp Val Gly Tyr Gly Ala Tyr Asp Leu Tyr Asp Leu  
Gly Glu Phe Asn Gln Lys Gly Thr Val Arg Thr Lys Tyr Gly Thr Lys Ala Gln Leu Lys Ser Ala Ile  
Asp Ala Leu His Lys Gln Asn Ile Asp Val Tyr Gly Asp Val Val Met Asn His Lys Gly Gly Ala Asp  
Tyr Thr Glu Thr Val Thr Ala Val Glu Val Asp Arg Asn Asn Arg Asn Ile Glu Val Ser Gly Asp Tyr  
Gln Ile Ser Ala Trp Thr Gly Phe Asn Phe Pro Gly Arg Gly Asp Ala Tyr Ser Asn Phe Lys Trp Lys  
Trp Tyr His Phe Asp Gly Thr Asp Trp Asp Glu Gly Arg Lys Leu Asn Arg Ile Tyr Lys Phe Arg Gly  
Val Asp Lys Ala Trp Asp Trp Glu Val Ser Ser Glu Asn Gly Asn Tyr Asp Tyr Leu Met Tyr Ala Asp  
Leu Asp Phe Asp His Pro Asp Val Ala Asn Glu Met Lys Asn Trp Gly Thr Trp Tyr Ala Asn Glu  
Leu Asn Leu Asp Gly Phe Arg Leu Asp Ala Val Lys His Ile Asp His Glu Tyr Leu Arg Asp Trp Val  
Asn His Ala Arg Gln Gln Thr Gly Lys Glu Met Phe Thr Val Ala Glu Tyr Trp Gln Asn Asp Val Gln  
Ala Leu Asn Asn Tyr Leu Ala Lys Val Asn Tyr Asn Gln Ser Val Phe Asp Ala Pro Leu His Tyr Asn  
Phe His Tyr Ala Ser Thr Gly Asn Gly Asn Tyr Asp Met Arg Asn Ile Leu Asn Gly Thr Val Met Lys  
Asn His Pro Ala Leu Ala Val Thr Leu Val Glu Asn His Asp Ser Gln Pro Gly Gln Ser Leu Glu Ser  
Val Val Ser Pro Trp Phe Lys Pro Leu Ala Tyr Ala Phe Ile Leu Thr Arg Ala Glu Gly Tyr Pro Ser  
Val Phe Tyr Gly Asp Tyr Tyr Gly Thr Ser Gly Asn Ser Ser Tyr Glu Ile Pro Ala Leu Lys Asp Lys  
Ile Asp Pro Ile Leu Thr Ala Arg Lys Asn Phe Ala Tyr Gly Thr Gln Arg Asp Tyr Leu Asp His Pro  
Asp Val Ile Gly Trp Thr Arg Glu Gly Asp Gly Val His Ala Asn Ser Gly Leu Ala Thr Leu Leu Ser  
Asp Gly Pro Gly Gly Ser Lys Trp Met Asp Val Gly Lys Asn Asn Ala Gly Glu Val Trp Tyr Asp Ile  
Thr Gly Asn Gln Thr Asn Thr Val Thr Ile Asn Lys Asp Gly Trp Gly Gln Phe Tyr Val Ser Gly Gly  
Ser Val Ser Ile Tyr Val Gln Arg

SEQ ID NO: 153

tgccttcaattaatgcaagcgattgcaaaaaaaggagataggagtatgaagaggaaaaatggactgcgtagcactatctttaccactagtt  
atgagcctatcaacaacatacaagcagaacattacataataaagggtcgaacaggaaataaagacggaaatttttatgaact  
gtatgtaattctttttatgatactgatagcaatggacatgggtgatttaaaaggcgtcacaagaaacttgattttaaatgatggaatccaagaac  
aaataatgatcttcaataaacggatctggtatgccttataacacctctcctagttatcacaatatgatgtaacagattactataatatcgatcct  
cagtatggaagtttacaagatttccgtgaactaacaacagaagcgcataaacgcaacgttaaaggtagtaatagatcttgttattaatcatacaagc  
agtgcagccttgggttctgatgcattaaaaataaaaaacagtaagatcgcagattactatattgggctgataaaaaatacagacttaaatgaaaa  
aggcccatggggtaacaagatggcacaagcgtcgaacggagagtattttacgcaacgttctgggaaggatgccgacttaactatga  
caaccctaaagtaagagaagaatgattaaatcgggaaattttggctcaacaaggagctgatggctttcgtctagatgcagccatgcacatctt  
taaagggcaaacacctgaaggagcaaaagaaaaatattgaatgggtgaatgaattccgcgacgcgatgagagaaacgaatccaatactatct  
agttggtgaaataggatcaaccagaagtagttgctccgtattatcaatcgttagattctacatttaacttcgacttagcatataaaatcgtaattcc  
gttaaaaatggtactgatcaaggggtagccgcggcagctgttgcaacggatgagttatataaaacataaatccaaataaaattgatggaacgttt  
ttaacgaatcatgacaaaatcgtgtaatgagtgagttaatgggtgatgtaaaacaaagcaaaatcagcagcctctattctgtgacactccctggt  
atccgttatttatttgccaagaagaatcgcatgacaggccaaaaaccagatgagttgattcgtgagcctttccgttgatgaagatgataaag  
aaggtcaaacgagctgggagactccagtatataacattgatcataatgggttttcagttgaagcacagaataacaaaaagcttcttctaagcc  
attatcgtaaaaatgattcgtgttcgtcgaacacgatgaactgtcaaggttaattagaacctattctgtcaaatccacaggttggtgcctataat  
cgtacgtataaaaaataatcaattcaagtgtaccataatattcagacaagccggttacattaactgtttcaacaaaggaaaactgatttttctagt  
gaattaggagcaaaaaaggaaaaatcaacattagtaattccagcgaatcacagctgtagtaaaagtaa



Figure 16LLL

SEQ ID NO: 154

Met Pro Ser Ile Asn Ala Ser Asp Cys Lys Lys Lys Gly Asp Arg Ser Met Lys Arg Lys Lys Trp Thr  
Ala Leu Ala Leu Ser Leu Pro Leu Val Met Ser Leu Ser Thr Asn Ile Gln Ala Glu Thr Leu His Asn  
Asn Lys Gly Gln Lys Ala Gln Thr Gly Asn Lys Asp Gly Ile Phe Tyr Glu Leu Tyr Val Asn Ser Phe  
Tyr Asp Thr Asp Ser Asn Gly His Gly Asp Leu Lys Gly Val Thr Lys Lys Leu Asp Tyr Leu Asn  
Asp Gly Asn Pro Arg Thr Asn Asn Asp Leu Gln Ile Asn Gly Ile Trp Met Met Pro Ile Asn Thr Ser  
Pro Ser Tyr His Lys Tyr Asp Val Thr Asp Tyr Tyr Asn Ile Asp Pro Gln Tyr Gly Ser Leu Gln Asp  
Phe Arg Glu Leu Thr Thr Glu Ala His Lys Arg Asn Val Lys Val Val Ile Asp Leu Val Ile Asn His  
Thr Ser Ser Glu His Pro Trp Phe Val Asp Ala Leu Lys Asn Lys Asn Ser Lys Tyr Arg Asp Tyr Tyr  
Ile Trp Ala Asp Lys Asn Thr Asp Leu Asn Glu Lys Gly Pro Trp Gly Gln Gln Val Trp His Lys Ala  
Ser Asn Gly Glu Tyr Phe Tyr Ala Thr Phe Trp Glu Gly Met Pro Asp Leu Asn Tyr Asp Asn Pro Lys  
Val Arg Glu Glu Met Ile Lys Ile Gly Lys Phe Trp Leu Lys Gln Gly Ala Asp Gly Phe Arg Leu Asp  
Ala Ala Met His Ile Phe Lys Gly Gln Thr Pro Glu Gly Ala Lys Lys Asn Ile Glu Trp Trp Asn Glu  
Phe Arg Asp Ala Met Arg Glu Thr Asn Pro Asn Thr Tyr Leu Val Gly Glu Ile Trp Asp Gln Pro Glu  
Val Val Ala Pro Tyr Tyr Gln Ser Leu Asp Ser Thr Phe Asn Phe Asp Leu Ala Tyr Lys Ile Val Asn  
Ser Val Lys Asn Gly Thr Asp Gln Gly Val Ala Ala Ala Val Ala Thr Asp Glu Leu Tyr Lys Thr  
Tyr Asn Pro Asn Lys Ile Asp Gly Thr Phe Leu Thr Asn His Asp Gln Asn Arg Val Met Ser Glu Leu  
Asn Gly Asp Val Asn Lys Ala Lys Ser Ala Ala Ser Ile Leu Leu Thr Leu Pro Gly Asn Pro Phe Ile  
Tyr Tyr Gly Glu Glu Ile Gly Met Thr Gly Gln Lys Pro Asp Glu Leu Ile Arg Glu Pro Phe Arg Trp  
Tyr Glu Asp Asp Lys Glu Gly Gln Thr Ser Trp Glu Thr Pro Val Tyr Asn Ile Asp His Asn Gly Val  
Ser Val Glu Ala Gln Asp Lys Gln Lys Ala Ser Leu Leu Ser His Tyr Arg Lys Met Ile Arg Val Arg  
Gln Gln His Asp Glu Leu Val Lys Gly Asn Leu Glu Pro Ile Ser Val Asn Asn Ser Gln Val Val Ala  
Tyr Asn Arg Thr Tyr Lys Asn Lys Ser Ile Gln Val Tyr His Asn Ile Ser Asp Lys Pro Val Thr Leu  
Thr Val Ser Asn Lys Gly Lys Leu Ile Phe Ser Ser Glu Leu Gly Ala Lys Lys Glu Lys Ser Thr Leu  
Val Ile Pro Ala Asn Thr Thr Val Leu Val Lys

SEQ ID NO: 155

gtgtcaagaatgtttgcaaaacgattcaaaacctcttactgccgttattcgcctgattttattgctgtttcatttggttctggcaggaccaacggctg  
cgaatgctgaacggctaacaatcaaatgagcttacagcaccgctgatcaaaagcggaaccattcttcattgcttgaattggtcgttcaatcgt  
taaacacaaatgaaggatattcatgatgcaggatatacagcgattcagacgtctccgattaaccaagtaaggaagggaaaccaaggaataa  
aaacatgtcgaactggtactggtctatcagccgacatcgtacaaattggcaaccgttacttaggtactgaacaagaatttaagaaatgtgtgc  
agccgctgaagaatatggcataaagggtattgttgacgcggtcatcaatcataccaccagtactatgccgcgatttccaatgagattaagagtatt  
ccaaactggacacatggaacacacaaataaaaactggtctgatcgatgggatgtcacgcagaatgcattgctcgggctgtatgactggaata  
cacaataacacaagtagctctatttgaacgggttctagaagagcattgaatgacggggcagacgggtttcgaattgatgccgccaacata  
tagagctccggatgatggcagttacggcagtcattttggccgaatatcacaatacatctgcagagttccaatcaggagaaatcctgcaggat  
agtgttcaagagatgcttcatatgcgaattatgaatgtgacagcgtctaactatgggcatccataaggtccgctttaagaatcgtaatctggg  
cgtgtcgaatatctcccactatgcacagatgtgtctgcggaacagctagtgacatgggtagaatcgcacatgatacgtatgccaatgatgatgaag  
agtcgacatggatgagcagatgatatccgtttaggctggcggtgatagcttctcgttcaggcagtagccctctttctttccagacctgaggg  
aggcggaatgggtgtgagattccgggggaaagccaaataggcgatcgcgaggagtgtttattgaagatcaggctatcactgcggtcaatag  
attcacaatgtgatggctggacagcctgaggaactctcgaacccaaatggaacaaccagatatttatgaatcagcgggctcatatggcgttg  
tgctggcaaatgcagggtcatcctctgtttctatcaatcgcgaacaaatgcctgatggcaggtatgataataaagctggggcaggttcaattca  
agtaaatgacggttaaactgacaggcagatcaatgccaggtctgtggtctgtgtttatcctgatgatattgcaaaagcgctcatgtttccttgag  
aattacaaaacaggtgtaacacattcttcaatgatcaactgacgattacactgcgtgcagatgcgaatacaacaaaagccgtttatcaaatcaata  
atggaccagagacggcggttaaggatggagatcaattcacaatcggaaggagatccatttggcaaaacatacaccatcatgttaaaaggaac  
gaacagtgtggtgtaacgaggaccgaggaatacagtttgttaaaagagatccagcttcggccaaaaccatcggtatcaaaatccgaatcatt  
ggagccaggtaaatgcttatctataaacatgatgggggcccgggca

SEQ ID NO: 156

Figure 16MMM



Applicant(s): Walter Callen et al.  
ENZYMES HAVING ALPHA AMYLASE ACTIVITY AND  
METHODS OF USE THEREOF

Val Ser Arg Met Phe Ala Lys Arg Phe Lys Thr Ser Leu Leu Pro Leu Phe Ala Gly Phe Leu Leu Leu  
Phe His Leu Val Leu Ala Gly Pro Thr Ala Ala Asn Ala Glu Thr Ala Asn Lys Ser Asn Glu Leu Thr  
Ala Pro Ser Ile Lys Ser Gly Thr Ile Leu His Ala Trp Asn Trp Ser Phe Asn Thr Leu Lys His Asn  
Met Lys Asp Ile His Asp Ala Gly Tyr Thr Ala Ile Gln Thr Ser Pro Ile Asn Gln Val Lys Glu Gly  
Asn Gln Gly Asn Lys Asn Met Ser Asn Trp Tyr Trp Leu Tyr Gln Pro Thr Ser Tyr Gln Ile Gly Asn  
Arg Tyr Leu Gly Thr Glu Gln Glu Phe Lys Glu Met Cys Ala Ala Ala Glu Glu Tyr Gly Ile Lys Val  
Ile Val Asp Ala Val Ile Asn His Thr Thr Ser Asp Tyr Ala Ala Ile Ser Asn Glu Ile Lys Ser Ile Pro  
Asn Trp Thr His Gly Asn Thr Gln Ile Lys Asn Trp Ser Asp Arg Trp Asp Val Thr Gln Asn Ala Leu  
Leu Gly Leu Tyr Asp Trp Asn Thr Gln Asn Thr Gln Val Gln Ser Tyr Leu Lys Arg Phe Leu Glu  
Arg Ala Leu Asn Asp Gly Ala Asp Gly Phe Arg Phe Asp Ala Ala Lys His Ile Glu Leu Pro Asp Asp  
Gly Ser Tyr Gly Ser Gln Phe Trp Pro Asn Ile Thr Asn Thr Ser Ala Glu Phe Gln Tyr Gly Glu Ile  
Leu Gln Asp Ser Ala Ser Arg Asp Ala Ser Tyr Ala Asn Tyr Met Asn Val Thr Ala Ser Asn Tyr Gly  
His Ser Ile Arg Ser Ala Leu Lys Asn Arg Asn Leu Gly Val Ser Asn Ile Ser His Tyr Ala Ser Asp  
Val Ser Ala Asp Lys Leu Val Thr Trp Val Glu Ser His Asp Thr Tyr Ala Asn Asp Asp Glu Glu Ser  
Thr Trp Met Ser Asp Asp Asp Ile Arg Leu Gly Trp Ala Val Ile Ala Ser Arg Ser Gly Ser Thr Pro  
Leu Phe Phe Ser Arg Pro Glu Gly Gly Gly Asn Gly Val Arg Phe Pro Gly Lys Ser Gln Ile Gly Asp  
Arg Gly Ser Ala Leu Phe Glu Asp Gln Ala Ile Thr Ala Val Asn Arg Phe His Asn Val Met Ala Gly  
Gln Pro Glu Glu Leu Ser Asn Pro Asn Gly Asn Asn Gln Ile Phe Met Asn Gln Arg Gly Ser His Gly  
Val Val Leu Ala Asn Ala Gly Ser Ser Ser Val Ser Ile Asn Thr Pro Thr Lys Leu Pro Asp Gly Arg  
Tyr Asp Asn Lys Ala Gly Ala Gly Ser Phe Gln Val Asn Asp Gly Lys Leu Thr Gly Thr Ile Asn Ala  
Arg Ser Val Ala Val Leu Tyr Pro Asp Asp Ile Ala Lys Ala Pro His Val Phe Leu Glu Asn Tyr Lys  
Thr Gly Val Thr His Ser Phe Asn Asp Gln Leu Thr Ile Thr Leu Arg Ala Asp Ala Asn Thr Thr Lys  
Ala Val Tyr Gln Ile Asn Asn Gly Pro Glu Thr Ala Phe Lys Asp Gly Asp Gln Phe Thr Ile Gly Lys  
Gly Asp Pro Phe Gly Lys Thr Tyr Thr Ile Met Leu Lys Gly Thr Asn Ser Asp Gly Val Thr Arg Thr  
Glu Glu Tyr Ser Phe Val Lys Arg Asp Pro Ala Ser Ala Lys Thr Ile Gly Tyr Gln Asn Pro Asn His  
Trp Ser Gln Val Asn Ala Tyr Ile Tyr Lys His Asp Gly Gly Arg Ala

SEQ ID NO: 157

atgcaaacgattgcaaaaaaggggatgaaacgatgaaagggaataatggacagcattagcttaacactgccgctggctgctagcttatca  
acaggcggtcacgccgaaaccgtacataaaggtaaacgtccaacagcagataaaacgggtgtctttatgaggtgtatgtaaactcttttacgat  
gcaataaagatggacatgggtgatttaaaaggcttacacaaaagctggattattgaatgacggcaattctcatacaaaatgatcttcaagtaa  
acggaatttggatgatgccgtaaaccttctctagctatcataaatgatgtaacggactattataacattgatccgcagtagcgaatctgca  
agatttgcgaagctgatgaaagaagcagataaacgagacgtaaaagggtattatggacctgtgtgaatcatacaagcagtgaaatccttggtt  
tcaagctgcattaaaagataaaaacagcaagtagacagagattactatatttggccgataaaaatactgatttaaatgaaaaggatcttgggggca  
gcaagtagtgcatgaaagctcaaacggagagatttttatgtacgttttgggaaggaaatgcctgacttaaatcagataatcccgaagtaagaaa  
agaaatgattaacgctcgggaaatttggctaaagcaaggcgtgacgggtccgcttagatgctgcgcttcataattttaaagggtcaaacacgtgaa  
ggcgctaagaaaaatcgtgtggtggaatgagtttagagatgcaatgaaaaagaaaaccctaacgtatatctaacgggtgaagtaggggac  
aacgggaagtagtagcttactatcaatcgttgattcttatttaactttgatttagcaggaaagattgtaaactctgtaaatcaggaaatgatca  
aggaatgcgactgcagcagccgcaactgatgagctgttcaatcatacaatccaaataaaattgacggcattttcttaaccaacctgacaaa  
atcgctcatgagtgaagcggcgatgtgaataaagcaaaagtcagctgcctctatcttactacgcttcctggcaaccggtatatttaccgg  
tgaagaaattggaatgaccggtgaaaagcctgatgagttatccgtgaaccgttccgctggtacgaaggcaatggacttgacaaccagctg  
gaaacatccgtatacaaaaaggcggcaatggtgtgtagtagacacaaacaaaaggattcttgttaaatcattaccgtaaatga  
ttcgctgcgtagcagcagcatgaagagtagtaaaaggaacccttcaatctatttcagtagacagtaagaagtcgttgccctatagccgcaggtata  
aaggcaatcgattagcgtgtatcataatattcaaatcaaccggtaaaagtagtctgtaacagcgaaaggtaaattgatttttctagtgaagggt  
gcaaaaaagtcaaaatcagctgtgtgtccagctaatacaacgggtttaataaaataa

SEQ ID NO: 158

Met Gln Thr Ile Ala Lys Lys Gly Asp Glu Thr Met Lys Gly Lys Lys Trp Thr Ala Leu Ala Leu Thr  
Leu Pro Leu Ala Ala Ser Leu Ser Thr Gly Val His Ala Glu Thr Val His Lys Gly Lys Ala Pro Thr  
Ala Asp Lys Asn Gly Val Phe Tyr Glu Val Tyr Val Asn Ser Phe Tyr Asp Ala Asn Lys Asp Gly His



Figure 16NNN

Applicant(s): Walter Callen et al.  
ENZYMES HAVING ALPHA AMYLASE ACTIVITY AND  
METHODS OF USE THEREOF

Gly Asp Leu Lys Gly Leu Thr Gln Lys Leu Asp Tyr Leu Asn Asp Gly Asn Ser His Thr Lys Asn  
Asp Leu Gln Val Asn Gly Ile Trp Met Met Pro Val Asn Pro Ser Pro Ser Tyr His Lys Tyr Asp Val  
Thr Asp Tyr Tyr Asn Ile Asp Pro Gln Tyr Gly Asn Leu Gln Asp Phe Arg Lys Leu Met Lys Glu Ala  
Asp Lys Arg Asp Val Lys Val Ile Met Asp Leu Val Val Asn His Thr Ser Ser Glu His Pro Trp Phe  
Gln Ala Ala Leu Lys Asp Lys Asn Ser Lys Tyr Arg Asp Tyr Tyr Ile Trp Ala Asp Lys Asn Thr Asp  
Leu Asn Glu Lys Gly Ser Trp Gly Gln Gln Val Trp His Lys Ala Pro Asn Gly Glu Tyr Phe Tyr Gly  
Thr Phe Trp Glu Gly Met Pro Asp Leu Asn Tyr Asp Asn Pro Glu Val Arg Lys Glu Met Ile Asn Val  
Gly Lys Phe Trp Leu Lys Gln Gly Val Asp Gly Phe Arg Leu Asp Ala Ala Leu His Ile Phe Lys Gly  
Gln Thr Pro Glu Gly Ala Lys Lys Asn Ile Val Trp Trp Asn Glu Phe Arg Asp Ala Met Lys Lys Glu  
Asn Pro Asn Val Tyr Leu Thr Gly Glu Val Trp Asp Gln Pro Glu Val Val Ala Pro Tyr Tyr Gln Ser  
Leu Asp Ser Leu Phe Asn Phe Asp Leu Ala Gly Lys Ile Val Asn Ser Val Lys Ser Gly Asn Asp Gln  
Gly Ile Ala Thr Ala Ala Ala Ala Thr Asp Glu Leu Phe Lys Ser Tyr Asn Pro Asn Lys Ile Asp Gly  
Ile Phe Leu Thr Asn His Asp Gln Asn Arg Val Met Ser Glu Leu Ser Gly Asp Val Asn Lys Ala Lys  
Ser Ala Ala Ser Ile Leu Leu Thr Leu Pro Gly Asn Pro Tyr Ile Tyr Tyr Gly Glu Glu Ile Gly Met Thr  
Gly Glu Lys Pro Asp Glu Leu Ile Arg Glu Pro Phe Arg Trp Tyr Glu Gly Asn Gly Leu Gly Gln Thr  
Ser Trp Glu Thr Ser Val Tyr Asn Lys Gly Gly Asn Gly Val Ser Val Glu Thr Gln Thr Lys Gln Lys  
Asp Ser Leu Leu Asn His Tyr Arg Glu Met Ile Arg Val Arg Gln Gln His Glu Glu Leu Val Lys Gly  
Thr Leu Gln Ser Ile Ser Val Asp Ser Lys Glu Val Val Ala Tyr Ser Arg Thr Tyr Lys Gly Lys Ser Ile  
Ser Val Tyr His Asn Ile Ser Asn Gln Pro Val Lys Val Ser Val Thr Ala Lys Gly Lys Leu Ile Phe Ala  
Ser Glu Lys Gly Ala Lys Lys Val Lys Asn Gln Leu Val Val Pro Ala Asn Thr Thr Val Leu Ile Lys

## SEQ ID NO: 159

ttgcaaaaaaagggtgatgaaacgatgaaagggaaaaaatggacagcttttagctctaacactgccgctggctgctagcttatcaacaggcgttc  
acgccgaaccgtacataaaggtaaatctccaacagcagataaaaacgggtgattttatgaggtgatgtaaacctcttttacgatgcaataaaga  
tggacatggtgatttaaaagggtctacacaaaagttggattttaaattgatggcaattctcatacaagaatgatcttcaagtaaacgggatttggat  
gatgccggtcaaccccttcccagctatcataaataatgatgtaacggactattataatattgatccgcagtatggaaatctgcaagatttgcgcaaac  
tgatgaaagaagcagataaacgagatgtaaaagtcattatggacctggttgtaatcatagcagcagtgaaacacccttgggttcaagctgcattaa  
aagataaaaacagcaagtagagattactatctgggctgataaaaataccgacttgaaatgaaaaaggatcttggggacagcaagtatggca  
taaagctccaaacggagagtattttacggaacgitttgggaaggaatgccggacttaaaattacgataatcctgaagtaagaaaagaatgattaa  
cgtaggaaagtttggctaaagcaaggagttagtggttccgtctagatgctgcgcttcatattttaaaggccaacacctgaaggcgctaagaa  
aaatctctctgtggtggaatgaatttagagatgcaatgaaaaaggaaaaccctaacgtatatacagggtgaagtatgggtaacacgggaagta  
gtagctcttactatcaatcgcttgattcttttaactttgatttagcaggaaagattgtaaatctgtaaaatcaggaaatgatcaaggaatcgga  
ctgcagcagcggcaacggatgaactgttcaaatcatacaatcaaaataaaattgacgggtattttcttaaccaaccatgacaaaaatcgcgctatga  
gtgagctaaacggcgatgtgaataaagcaaacgagctgcctctatcttactacgcttctggcaacccgtatattattacggtagaagaaatcg  
catgaccgggtgaaaagcctgatgagtaaatccgtgaaccgttccccgtgtacgaaggaaacggacttgacaaccagctgggaaacacctgt  
atatacaaaaggcggcaacggcgtgtctgtagaagcacaacaaaacaaaaggactcttggtaaatcattaccgtgaaatgattcgctgcgtc  
agcagcacgaagagtagtaaaaggaacgcttcaatctatttcagtagacagtaagaagtcgttgcctatagccgtacgtataaaggcaaatcg  
attagcgtgtatcataatatttcaaatcaaccggtaaaagatctgtagcagcaaaaggtaaatgattttgctagtgaaaaagggtgctaagaaagt  
caaaaatcagctgtgattccggcgaatacaacgggttttaataaaaataa

## SEQ ID NO: 160

Met Gln Lys Lys Gly Asp Glu Thr Met Lys Gly Lys Lys Trp Thr Ala Leu Ala Leu Thr Leu Pro  
Leu Ala Ala Ser Leu Ser Thr Gly Val His Ala Glu Thr Val His Lys Gly Lys Ser Pro Thr Ala Asp  
Lys Asn Gly Val Phe Tyr Glu Val Tyr Val Asn Ser Phe Tyr Asp Ala Asn Lys Asp Gly His Gly Asp  
Leu Lys Gly Leu Thr Gln Lys Leu Asp Tyr Leu Asn Asp Gly Asn Ser His Thr Lys Asn Asp Leu  
Gln Val Asn Gly Ile Trp Met Met Pro Val Asn Pro Ser Pro Ser Tyr His Lys Tyr Asp Val Thr Asp  
Tyr Tyr Asn Ile Asp Pro Gln Tyr Gly Asn Leu Gln Asp Phe Arg Lys Leu Met Lys Glu Ala Asp  
Lys Arg Asp Val Lys Val Ile Met Asp Leu Val Val Asn His Thr Ser Ser Glu His Pro Trp Phe Gln  
Ala Ala Leu Lys Asp Lys Asn Ser Lys Tyr Arg Asp Tyr Tyr Ile Trp Ala Asp Lys Asn Thr Asp Leu  
Asn Glu Lys Gly Ser Trp Gly Gln Gln Val Trp His Lys Ala Pro Asn Gly Glu Tyr Phe Tyr Gly Thr

Figure 16000



Phe Trp Glu Gly Met Pro Asp Leu Asn Tyr Asp Asn Pro Glu Val Arg Lys Glu Met Ile Asn Val Gly  
Lys Phe Trp Leu Lys Gln Gly Val Asp Gly Phe Arg Leu Asp Ala Ala Leu His Ile Phe Lys Gly Gln  
Thr Pro Glu Gly Ala Lys Lys Asn Leu Leu Trp Trp Asn Glu Phe Arg Asp Ala Met Lys Lys Glu  
Asn Pro Asn Val Tyr Leu Thr Gly Glu Val Trp Asp Gln Pro Glu Val Val Ala Pro Tyr Tyr Gln Ser  
Leu Asp Ser Leu Phe Asn Phe Asp Leu Ala Gly Lys Ile Val Asn Ser Val Lys Ser Gly Asn Asp Gln  
Gly Ile Ala Thr Ala Ala Ala Thr Asp Glu Leu Phe Lys Ser Tyr Asn Pro Asn Lys Ile Asp Gly  
Ile Phe Leu Thr Asn His Asp Gln Asn Arg Val Met Ser Glu Leu Asn Gly Asp Val Asn Lys Ala Lys  
Ser Ala Ala Ser Ile Leu Leu Thr Leu Pro Gly Asn Pro Tyr Ile Tyr Tyr Gly Glu Glu Ile Gly Met Thr  
Gly Glu Lys Pro Asp Glu Leu Ile Arg Glu Pro Phe Pro Trp Tyr Glu Gly Asn Gly Leu Gly Gln Thr  
Ser Trp Glu Thr Pro Val Tyr Asn Lys Gly Gly Asn Gly Val Ser Val Glu Ala Gln Thr Lys Gln Lys  
Asp Ser Leu Leu Asn His Tyr Arg Glu Met Ile Arg Val Arg Gln Gln His Glu Glu Leu Val Lys Gly  
Thr Leu Gln Ser Ile Ser Val Asp Ser Lys Glu Val Val Ala Tyr Ser Arg Thr Tyr Lys Gly Lys Ser Ile  
Ser Val Tyr His Asn Ile Ser Asn Gln Pro Val Lys Val Ser Val Ala Ala Lys Gly Lys Leu Ile Phe Ala  
Ser Glu Lys Gly Ala Lys Lys Val Lys Asn Gln Leu Val Ile Pro Ala Asn Thr Thr Val Leu Ile Lys

## SEQ ID NO: 161

gtggatccaaagaattgtagtcatttatgcaaacgattgcaaaaaaggggatgaacgatgaaagggaataatggacagcttagctctaa  
cactgccgctggctgctagcttatcaacaggtgttcacgccgaaaccgtacataaaggtaaagctccaacagcagataaaaacgggtctttat  
gaggtatatgtaaactcttttacgatgcaataaagatggacatgggtgatttaaaaggccttacacaaaagttggactatttaaatgacggaaattc  
tcatacaaagaatgatcttcaagtaaacgggatttggatgatgccggtcaacccttccttagctatcataaatatgatgtaacggactattataat  
tgatccgcagtatggaatctgcaagatttgcgaacttatgaaagaagcagataaacgagacgtaaaagtcattatggaccttgtgtgaatcat  
acgagcagtgaaaccccttgggttcaagctgcgttgaaagataaaaacagcaagtacagagattactatatttgggctgataaaaactgacttg  
aatgaaaaaggatcttggggacaacaagtatggcataaagctccaacaggagatattttacggaacgttctgggaagggaatgcctgacttaa  
attacgataaccctgaagtaagaaaaaagaatgattaacgtcggaagtttggctaaacaaggcgttgacggctccgcttagatgctgcccttc  
atatttttaaggtaaacgcctgaaggcgctaaagaaaacattctatggtggaatgagtttagatgcatgaaaaaagaaaacccgaacgta  
tatctaacgggtgaagtgtgggaccagccagaagtagtagcccttactatcaatcacttgattctctatttaattttgatttagcaggaataattgtc  
agctctgtaaaagcaggaaatgatcaaggaatcgccactgcagcagcggaactgatgagctgttcaaatcataaatccaaataaaattgacg  
gcattttcttaaccaacctgacaaaatcgcgctcatgagtgaagtggaagcgatgtaataaagcaaaatcagccgctctacttactacgct  
tcttggaatccgtatatttattacggtgaagaaattggcatgacaggtgaaaagcctgatgaattaatccgtgaaccgtccgctggtacgaagg  
caacggaattggacaaactagctgggaaacacctgtatatacaaaggcggtaacggcgtgtctgtagaagcacaacaaaaacaaaggatt  
cctgttaaatcattaccgtgaaatgattcgtgtgcgccagcagcacgaagagttagtaaaaggaacgcttcaatccatttcagtagacagtaaaag  
aagtcgttgccatagccgcacgtacaaaggcaaatcgattagcgtgtatcataatatttcaaatcaacctgtaaaagtatctgtagcagcgaag  
gtaacttgattttgctagtgaaaaagggtgtaagaaagtcataaatcagctgtgattccggcgaatgcgacgggtttaataaaaaataa

## SEQ ID NO: 162

Val Asp Pro Lys Asn Cys Ser Gln Phe Met Gln Thr Ile Ala Lys Lys Gly Asp Glu Thr Met Lys Gly  
Lys Lys Trp Thr Ala Leu Ala Leu Thr Leu Pro Leu Ala Ala Ser Leu Ser Thr Gly Val His Ala Glu  
Thr Val His Lys Gly Lys Ala Pro Thr Ala Asp Lys Asn Gly Val Phe Tyr Glu Val Tyr Val Asn Ser  
Phe Tyr Asp Ala Asn Lys Asp Gly His Gly Asp Leu Lys Gly Leu Thr Gln Lys Leu Asp Tyr Leu  
Asn Asp Gly Asn Ser His Thr Lys Asn Asp Leu Gln Val Asn Gly Ile Trp Met Met Pro Val Asn Pro  
Ser Pro Ser Tyr His Lys Tyr Asp Val Thr Asp Tyr Tyr Asn Ile Asp Pro Gln Tyr Gly Asn Leu Gln  
Asp Phe Arg Lys Leu Met Lys Glu Ala Asp Lys Arg Asp Val Lys Val Ile Met Asp Leu Val Val  
Asn His Thr Ser Ser Glu His Pro Trp Phe Gln Ala Ala Leu Lys Asp Lys Asn Ser Lys Tyr Arg Asp  
Tyr Tyr Ile Trp Ala Asp Lys Asn Thr Asp Leu Asn Glu Lys Gly Ser Trp Gly Gln Gln Val Trp His  
Lys Ala Pro Asn Gly Glu Tyr Phe Tyr Gly Thr Phe Trp Glu Gly Met Pro Asp Leu Asn Tyr Asp  
Asn Pro Glu Val Arg Lys Glu Met Ile Asn Val Gly Lys Phe Trp Leu Lys Gln Gly Val Asp Gly Phe  
Arg Leu Asp Ala Ala Leu His Ile Phe Lys Gly Gln Thr Pro Glu Gly Ala Lys Lys Asn Ile Leu Trp  
Trp Asn Glu Phe Arg Asp Ala Met Lys Lys Glu Asn Pro Asn Val Tyr Leu Thr Gly Glu Val Trp  
Asp Gln Pro Glu Val Val Ala Pro Tyr Tyr Gln Ser Leu Asp Ser Leu Phe Asn Phe Asp Leu Ala Gly  
Lys Ile Val Ser Ser Val Lys Ala Gly Asn Asp Gln Gly Ile Ala Thr Ala Ala Ala Thr Asp Glu



Figure 16PPP

Leu Phe Lys Ser Tyr Asn Pro Asn Lys Ile Asp Gly Ile Phe Leu Thr Asn His Asp Gln Asn Arg Val  
Met Ser Glu Leu Ser Gly Asp Val Asn Lys Ala Lys Ser Ala Ala Ser Ile Leu Leu Thr Leu Pro Gly  
Asn Pro Tyr Ile Tyr Tyr Gly Glu Glu Ile Gly Met Thr Gly Glu Lys Pro Asp Glu Leu Ile Arg Glu  
Pro Phe Arg Trp Tyr Glu Gly Asn Gly Ile Gly Gln Thr Ser Trp Glu Thr Pro Val Tyr Asn Lys Gly  
Gly Asn Gly Val Ser Val Glu Ala Gln Thr Lys Gln Lys Asp Ser Leu Leu Asn His Tyr Arg Glu Met  
Ile Arg Val Arg Gln Gln His Glu Glu Leu Val Lys Gly Thr Leu Gln Ser Ile Ser Val Asp Ser Lys  
Glu Val Val Ala Tyr Ser Arg Thr Tyr Lys Gly Lys Ser Ile Ser Val Tyr His Asn Ile Ser Asn Gln Pro  
Val Lys Val Ser Val Ala Ala Lys Gly Asn Leu Ile Phe Ala Ser Glu Lys Gly Ala Lys Lys Val Lys  
Asn Gln Leu Val Ile Pro Ala Asn Ala Thr Val Leu Ile Lys

SEQ ID NO: 163

atggtacgtcccgaacgacgggctgattggaaccgactatcgaacgactcgcagcacttgaagacattgggtgacgacggtgtgattccg  
ccggcgtaaaaggcagctcacagaacgatgctgggtatggggcgtacgatttatacgatctggcgaattcaacaaaaaggacgacccg  
gacgaagtacgggacgaaagcgcagctccagaccgccatctcgaacttgcgcggttaaagggtcgggtgttacggcgacgtcgtatgaat  
cacaaggcgggggccgattataccgaatccgttcaggcgatcgaggtaacccgtcgaaccggaaccaagaacgtccgggtgagtatggcat  
ctcgccctggactgggttcaacttcgcggggcgaacaatacactcgccttcaaatggcgctgtgtaccattttgacgggtaccgattgggac  
agtcacgcagcttgagccgcatctataagttcaagagcacaggcaaggcgtgggacacggacgtgtcgaacgagaacggcaactatgattat  
cttatgtatgccgacgtcgaatttcgagcatcccgaggtccgccaaagagatgaagaactggggcaaatggtacgccgactcgtcgggctcgac  
ggtttcgggttgatgcggtcaaacatcagccactcgtactgaaggagtggtgacgagcgtgcgccagacgaccgggaaagagatgttc  
acggtcgccgagtatgtgaagaacgatctcgggtccatcaacgactatctgtataagacgggctacacgcactccgtcttcgatgtgccgctcc  
attataactccaagcgccggtaacggcgccgggtattacgatatgcgcaacatcttgaaggcaccgtcaccgaacagcatccgtcgtgtc  
cgtgacgattgtcgataaccagactcagacggcgccagtcgctcagtcgacggtcgcgaactggttcaaacggctcgcctacgcgacga  
tcattgacgcgcggtcagggttatccggccctctctatggagactattatggcacgaaaggagacgaaccgcgaatccgaacatgtcgg  
gcacgctccaaccgatttgaaggcacgaaaagattcgcctacgggacgcagcatgactacctcgatcatcaggacgtcagctggctggacac  
gtgaagggtgacccgaccgtgccaatcggtctcgcgacgattctatggacgggtccggcggtcgaagtggatgtacgtcggcaaacag  
aacgccggcgaggtatggaagacatgacgaacaacacgccgctctgtcacgatcaatgctgacgggtggggtcagttcttcgtcaacgg  
aggctcggctcgtattatcgaacaataa

SEQ ID NO: 164

Met Val Arg Pro Glu Arg Arg Ala Ala Leu Glu Pro Thr Ile Glu Arg Leu Ala Ala Leu Glu Arg His  
Trp Val Thr Thr Val Trp Ile Pro Pro Ala Tyr Lys Gly Thr Ser Gln Asn Asp Val Gly Tyr Gly Ala  
Tyr Asp Leu Tyr Asp Leu Gly Glu Phe Asn Gln Lys Gly Thr Thr Arg Thr Lys Tyr Gly Thr Lys  
Ala Gln Leu Gln Thr Ala Ile Ser Asn Leu Arg Gly Lys Gly Ile Gly Val Tyr Gly Asp Val Val Met  
Asn His Lys Gly Gly Ala Asp Tyr Thr Glu Ser Val Gln Ala Ile Glu Val Asn Pro Ser Asn Arg Asn  
Gln Glu Thr Ser Gly Glu Tyr Gly Ile Ser Ala Trp Thr Gly Phe Asn Phe Ala Gly Arg Asn Asn Thr  
Tyr Ser Pro Phe Lys Trp Arg Trp Tyr His Phe Asp Gly Thr Asp Trp Asp Gln Ser Arg Ser Leu Ser  
Arg Ile Tyr Lys Phe Lys Ser Thr Gly Lys Ala Trp Asp Thr Asp Val Ser Asn Glu Asn Gly Asn Tyr  
Asp Tyr Leu Met Tyr Ala Asp Val Asp Phe Glu His Pro Glu Val Arg Gln Glu Met Lys Asn Trp  
Gly Lys Trp Tyr Ala Asp Ser Leu Gly Leu Asp Gly Phe Arg Leu Asp Ala Val Lys His Ile Ser His  
Ser Tyr Leu Lys Glu Trp Val Thr Ser Val Arg Gln Thr Thr Gly Lys Glu Met Phe Thr Val Ala Glu  
Tyr Trp Lys Asn Asp Leu Gly Ala Ile Asn Asp Tyr Leu Tyr Lys Thr Gly Tyr Thr His Ser Val Phe  
Asp Val Pro Leu His Tyr Asn Phe Gln Ala Ala Gly Asn Gly Gly Gly Tyr Tyr Asp Met Arg Asn Ile  
Leu Lys Gly Thr Val Thr Glu Gln His Pro Ser Leu Ser Val Thr Ile Val Asp Asn His Asp Ser Gln  
Pro Gly Gln Ser Leu Glu Ser Thr Val Ala Asn Trp Phe Lys Pro Leu Ala Tyr Ala Thr Ile Met Thr  
Arg Gly Gln Gly Tyr Pro Ala Leu Phe Tyr Gly Asp Tyr Tyr Gly Thr Lys Gly Thr Thr Asn Arg Glu  
Ile Pro Asn Met Ser Gly Thr Leu Gln Pro Ile Leu Lys Ala Arg Lys Asp Phe Ala Tyr Gly Thr Gln  
His Asp Tyr Leu Asp His Gln Asp Val Ile Gly Trp Thr Arg Glu Gly Val Thr Asp Arg Ala Lys Ser  
Gly Leu Ala Thr Ile Leu Ser Asp Gly Pro Gly Gly Ser Lys Trp Met Tyr Val Gly Lys Gln Asn Ala  
Gly Glu Val Trp Lys Asp Met Thr Asn Asn Asn Ala Arg Leu Val Thr Ile Asn Ala Asp Gly Trp Gly  
Gln Phe Phe Val Asn Gly Gly Ser Val Ser Ile Tyr Thr Gln Gln

Figure 16QQQ



SEQ ID NO: 165

atgcagtatattcagtggtacgtgccaaatgatggggaacattggaatcgtttgcgtaatgatgctgaaaattagctcataaaggaattacatctgt  
atggataccaccggtatataaaggaacttcacaaaatgatgtagggtatggagtgtatgatgtatatgatttgggagaattcaatcaaaaaggaac  
gatacggacaaaatattggacaaaagcacaattaaaaatctgcaattgaggctttacataatcaaaatcgcgtgtatcgggtgatgtgtatgaac  
cataaaggtggggcagattatactgaggttgtaacagccgttgaggtagaccgtaacaatcgaatattgaaacatcgagtgattatcaaatagat  
gcgtggacgggattgtttccaggacgcagggactcctattctaattttaaatggagatgggttcattttgatggaacagattgggatgaggga  
ggaaattaaatagaattataaatttaaaggcgtaggttaaagcttgggactgggaagtgtctagtgagaatggtaactatgattatttaattgatga  
gatcttgatttcgatcatcctgaagttgcaaatgaaatgaaaactggggaacctgggtatgcggacgaattaaatttagatggctttcgttagacg  
cagttaaacataattgacatgagtatctctgtgattgggtaaatcatgtagaaagcaaacggggaaggaaatgtttacagtagctgaattatggca  
aaatgatattcgtactttaacaatttttagggaaagtaaattataatcaatctgtgttcgatgcaccttccattataattttcattatgcttcaacagg  
gaatggaaattatgatatgaggaatttttaaagggtacggttagtagaaagtcacctacacttgctgttactctgttgagaatcatgattctcagcc  
tggacagtcattagaatctgtgtgagtccttggttaagccgttggcctatgcattattttaacgcgtgcagaagggtatccttctgtttttatggag  
attactatggcacaaatggaaatagtagttatgaaattccaacgttaaaggataaaattgatccaattctgacggcacgaaaaaactttgcatatgg  
tacgcaacatgattatttagacatccagatgtgattggctggacaagagaaggggtagtatacatgctaattctggttagcaacattaatctctg  
atggaccaggagatcaaaatggatgaatgttggaagaacaacgcaggggaaatatggtacgatattacgggcaatcaacaaatactgtaa  
cgattaataaagatggatgggggcagttccatgtaaattgggggctctgtttcaatatatgttcagaagtaa

SEQ ID NO: 166

Met Gln Tyr Phe Glu Trp Tyr Val Pro Asn Asp Gly Glu His Trp Asn Arg Leu Arg Asn Asp Ala  
Glu Asn Leu Ala His Lys Gly Ile Thr Ser Val Trp Ile Pro Pro Val Tyr Lys Gly Thr Ser Gln Asn  
Asp Val Gly Tyr Gly Val Tyr Asp Val Tyr Asp Leu Gly Glu Phe Asn Gln Lys Gly Thr Ile Arg Thr  
Lys Tyr Gly Thr Lys Ala Gln Leu Lys Ser Ala Ile Glu Ala Leu His Asn Gln Asn Ile Asp Val Tyr  
Gly Asp Val Val Met Asn His Lys Gly Gly Ala Asp Tyr Thr Glu Val Val Thr Ala Val Glu Val Asp  
Arg Asn Asn Arg Asn Ile Glu Thr Ser Ser Asp Tyr Gln Ile Asp Ala Trp Thr Gly Phe Asp Phe Pro  
Gly Arg Arg Asp Ser Tyr Ser Asn Phe Lys Trp Arg Trp Phe His Phe Asp Gly Thr Asp Trp Asp Glu  
Gly Arg Lys Leu Asn Arg Ile Tyr Lys Phe Lys Gly Val Gly Lys Ala Trp Asp Trp Glu Val Ser Ser  
Glu Asn Gly Asn Tyr Asp Tyr Leu Met Tyr Ala Asp Leu Asp Phe Asp His Pro Glu Val Ala Asn  
Glu Met Lys Asn Trp Gly Thr Trp Tyr Ala Asp Glu Leu Asn Leu Asp Gly Phe Arg Leu Asp Ala  
Val Lys His Ile Asp His Glu Tyr Leu Arg Asp Trp Val Asn His Val Arg Lys Gln Thr Gly Lys Glu  
Met Phe Thr Val Ala Glu Tyr Trp Gln Asn Asp Ile Arg Thr Leu Asn Asn Tyr Leu Gly Lys Val Asn  
Tyr Asn Gln Ser Val Phe Asp Ala Pro Leu His Tyr Asn Phe His Tyr Ala Ser Thr Gly Asn Gly Asn  
Tyr Asp Met Arg Asn Ile Leu Lys Gly Thr Val Val Glu Ser His Pro Thr Leu Ala Val Thr Leu Val  
Glu Asn His Asp Ser Gln Pro Gly Gln Ser Leu Glu Ser Val Val Ser Pro Trp Phe Lys Pro Leu Ala  
Tyr Ala Phe Ile Leu Thr Arg Ala Glu Gly Tyr Pro Ser Val Phe Tyr Gly Asp Tyr Tyr Gly Thr Asn  
Gly Asn Ser Ser Tyr Glu Ile Pro Thr Leu Lys Asp Lys Ile Asp Pro Ile Leu Thr Ala Arg Lys Asn  
Phe Ala Tyr Gly Thr Gln His Asp Tyr Leu Asp His Pro Asp Val Ile Gly Trp Thr Arg Glu Gly Asp  
Ser Ile His Ala Asn Ser Gly Leu Ala Thr Leu Ile Ser Asp Gly Pro Gly Gly Ser Lys Trp Met Asn  
Val Gly Lys Asn Asn Ala Gly Glu Ile Trp Tyr Asp Ile Thr Gly Asn Gln Thr Asn Thr Val Thr Ile  
Asn Lys Asp Gly Trp Gly Gln Phe His Val Asn Gly Gly Ser Val Ser Ile Tyr Val Gln Lys

SEQ ID NO: 167

atgcaaacgattgcaaaaaaggggatgaaacgatgaaagggaataatggacagcttttagcttaacactgccgctggctgctagcttatca  
acaggcgttcacgccgaaccgtacataaaggtaaatctccaacagcagataaaaacgggtgattttatgaggtgtatgaaactcttttacgatg  
caataaagatggacatgggtgatttaaaggcttacacaaaagtggattatttaaattgatggcaattctcatcaaaagaatgatcttcaagtaaac  
gggatttgatgacgggtcaacccttctccagctatcataaatatgatgtaacggactattataattgatccgcagtatggaatctgcaag  
attttcgcaactgatgaaagaagcagataaacgagatgtaaaagtcattatggacctcgttgtaatcatacgagcagtgaacaccttggttc  
aagctgcattaaagataaaaacgagacagagattactatctgggctgataaaaataccgacttgaatgaaaaggatcttggggaca  
gcaagtatggcataaagcccaaacggagagtattttacggaacgttttgggaagggaatgccggacttaattacgataatcctgaagtaagaa  
aagaaatgattaacgtaggaaagtttggctaaagcaaggagttgacgggttcgcttagatgctgcgctcatattttaaaggccaaacacctg



Figure 16RRR

aaggcgctaagaaaaatcctctgtggtggaatgaatttagagatgcaatgaaaaaggaaaaccctaactatatacgggtgaagtatggga  
tcaaccggaagtagtagctcttactatcaatcgcttgattctttatttaactttgatttagcaggaaagattgtaaacctgtaaaatcaggaatgat  
caaggaatcgcgactgcagcagcggaacggatgaactgttcaaatcatacaatccaaataaaattgacgggtattttcttaaccaacctgacca  
aaatcgctcatgagtgagctaagcggcgatgtgaataaagcaaaagtcagctgacctatcttacttacgcttctcggaacccgtatatttattac  
gggtgaagaaatcgcatgaccgggtgaaaagcctgatgagttaatccgtgaaccgttccgctgtgtacgaaggaaacggacttggacaaaccag  
ctgggaaacacctgtatacaacaaaggcggcaacggcggtgtctgtagaagcacaacaaacaaaaggactcttgttaaatcattaccgtgaa  
atgattcgctgcgtcagcagcagcaagagtagtaaaaggaacgcttcaatctatttcagtagacagtaaaagaagtcgttgccatagccgcac  
gtataaaggcaatcgattagcgtgtatcataatatttcaaatcaaccggtaaaagtatctgtagcagcaaaaggtaaatgatttttgtagtgaaa  
aagggtgctaagaaagtcacaaatcagcttgtgattccggcgcaatacaacgggtttaataaaaaaa

SEQ ID NO: 168

Met Gln Thr Ile Ala Lys Lys Gly Asp Glu Thr Met Lys Gly Lys Lys Trp Thr Ala Leu Ala Leu Thr  
Leu Pro Leu Ala Ala Ser Leu Ser Thr Gly Val His Ala Glu Thr Val His Lys Gly Lys Ser Pro Thr  
Ala Asp Lys Asn Gly Val Phe Tyr Glu Val Tyr Val Asn Ser Phe Tyr Asp Ala Asn Lys Asp Gly His  
Gly Asp Leu Lys Gly Leu Thr Gln Lys Leu Asp Tyr Leu Asn Asp Gly Asn Ser His Thr Lys Asn  
Asp Leu Gln Val Asn Gly Ile Trp Met Met Pro Val Asn Pro Ser Pro Ser Tyr His Lys Tyr Asp Val  
Thr Asp Tyr Tyr Asn Ile Asp Pro Gln Tyr Gly Asn Leu Gln Asp Phe Arg Lys Leu Met Lys Glu Ala  
Asp Lys Arg Asp Val Lys Val Ile Met Asp Leu Val Val Asn His Thr Ser Ser Glu His Pro Trp Phe  
Gln Ala Ala Leu Lys Asp Lys Asn Ser Lys Tyr Arg Asp Tyr Tyr Ile Trp Ala Asp Lys Asn Thr Asp  
Leu Asn Glu Lys Gly Ser Trp Gly Gln Gln Val Trp His Lys Ala Pro Asn Gly Glu Tyr Phe Tyr Gly  
Thr Phe Trp Glu Gly Met Pro Asp Leu Asn Tyr Asp Asn Pro Glu Val Arg Lys Glu Met Ile Asn Val  
Gly Lys Phe Trp Leu Lys Gln Gly Val Asp Gly Phe Arg Leu Asp Ala Ala Leu His Ile Phe Lys Gly  
Gln Thr Pro Glu Gly Ala Lys Lys Asn Leu Leu Trp Trp Asn Glu Phe Arg Asp Ala Met Lys Lys  
Glu Asn Pro Asn Val Tyr Leu Thr Gly Glu Val Trp Asp Gln Pro Glu Val Val Ala Pro Tyr Tyr Gln  
Ser Leu Asp Ser Leu Phe Asn Phe Asp Leu Ala Gly Lys Ile Val Asn Ser Val Lys Ser Gly Asn Asp  
Gln Gly Ile Ala Thr Ala Ala Ala Thr Asp Glu Leu Phe Lys Ser Tyr Asn Pro Asn Lys Ile Asp  
Gly Ile Phe Leu Thr Asn His Asp Gln Asn Arg Val Met Ser Glu Leu Ser Gly Asp Val Asn Lys Ala  
Lys Ser Ala Ala Ser Ile Leu Leu Thr Leu Pro Gly Asn Pro Tyr Ile Tyr Tyr Gly Glu Glu Ile Gly Met  
Thr Gly Glu Lys Pro Asp Glu Leu Ile Arg Glu Pro Phe Arg Trp Tyr Glu Gly Asn Gly Leu Gly Gln  
Thr Ser Trp Glu Thr Pro Val Tyr Asn Lys Gly Gly Asn Gly Val Ser Val Glu Ala Gln Thr Lys Gln  
Lys Asp Ser Leu Leu Asn His Tyr Arg Glu Met Ile Arg Val Arg Gln Gln His Glu Glu Leu Val Lys  
Gly Thr Leu Gln Ser Ile Ser Val Asp Ser Lys Glu Val Val Ala Tyr Ser Arg Thr Tyr Lys Gly Lys  
Ser Ile Ser Val Tyr His Asn Ile Ser Asn Gln Pro Val Lys Val Ser Val Ala Ala Lys Gly Lys Leu Ile  
Phe Gly Ser Glu Lys Gly Ala Lys Lys Val Lys Asn Gln Leu Val Ile Pro Ala Asn Thr Thr Val Leu  
Ile Lys

SEQ ID NO: 169

atgaaaacattcaaataaaacgcactttttaccgctaacccttgcgtcagtcctctgctgggcaaaatggcaccatgatgcagtattt  
cattggtatgtacctaattgatggcgcaattatggacgcaggtgaaagcaatgctccagcactcgtgaaaacgggtttacagcgctctggctacc  
gccagcttacaaaggcgcggcgaggaatgacgtcggttatggcgtctatgatattgacgatttaggtgagttgatcaaaaggctcagtac  
gaaccaaatacggcaccaaggctcagtaactctctgcaatcaatgccgcgcacaacaataatccaaatctacggcgatgtgtgtttaaccac  
cgaggtggtgctgatgggaagtcgtgggtcgataccaagcgcgttgattgggacaccgtaacattgaactgggcgacaaatggattgaagct  
tgggttgatgttaatttctggcgcaacaaatactcaaacctccattggacttggtatcactttgacggtgtgactgggatgatgccggcaa  
agaaaaagcgatctttaaattcaaaggcgaaggaaaagcatgggattgggaagtcagctctgaaaaaggcaattacgactacctaattgacgc  
cgatttagacatggatcaccaagaagtaacaagagctgaaagattgggtgagtggtacatcaacatgaccggcggttagtgctttagaattg  
gatgccgtgaagcacattaaatcatgattctacaagagtggttgatcatttacgttggaacaggcgaagagctttaccggttggtgagttat  
ggaattacgacgtaaatcaactgcataactttattactaagacctctggcagtatgtcgttggtcagtcgccgcttcacatgaactctacaacgcg  
tcaaaatctggcggaattacgatatgcgcaaatcatgaatggcaggtgatgaaggacaaccagtcgaagctgtgactctcgtagaaaacc  
acgatacacagccattgcaggcgtagagtcgacagtggttggttgcaagcctctgcttacgcattcattttattgcgtgaagaaggttatcc  
atcagtggttacgcagattactacggcgcgagtagcagcacaaggtacacatcaatattggccaaagttccttactgaagaacttgtaa

Figure 16SSS



Applicant(s): Walter Callen et al.  
ENZYMES HAVING ALPHA AMYLASE ACTIVITY AND  
METHODS OF USE THEREOF

cactgcgtaaagagtatgcgtatggcaaacagaattcttatctcgaccactgggatgtgattggctggacccgagagggcgatgctgaacatcc  
aaactcaatggcggtgatcatgatgatggaccaggtggcaaaaatggatgtataccggtgaagccaagcacgcgctatgtcgacaagctgg  
gtatccgaactgaagaagtttgaccgataccaatggctgggcagaatttctgtcaatgggtggttcagtcctgggttggtggcgtaagtaa

SEQ ID NO: 170

Met Lys Thr Phe Lys Leu Lys Arg Thr Phe Leu Pro Leu Thr Leu Leu Ser Ala Pro Ala Phe Ala  
Gly Gln Asn Gly Thr Met Met Gln Tyr Phe His Trp Tyr Val Pro Asn Asp Gly Ala Leu Trp Thr Gln  
Val Glu Ser Asn Ala Pro Ala Leu Ala Glu Asn Gly Phe Thr Ala Leu Trp Leu Pro Pro Ala Tyr Lys  
Gly Ala Gly Gly Ser Asn Asp Val Gly Tyr Gly Val Tyr Asp Met Tyr Asp Leu Gly Glu Phe Asp  
Gln Lys Gly Ser Val Arg Thr Lys Tyr Gly Thr Lys Ala Gln Tyr Ile Ser Ala Ile Asn Ala Ala His  
Asn Asn Asn Ile Gln Ile Tyr Gly Asp Val Val Phe Asn His Arg Gly Gly Ala Asp Gly Lys Ser Trp  
Val Asp Thr Lys Arg Val Asp Trp Asp Asn Arg Asn Ile Glu Leu Gly Asp Lys Trp Ile Glu Ala Trp  
Val Glu Phe Asn Phe Pro Gly Arg Asn Asp Lys Tyr Ser Asn Phe His Trp Thr Trp Tyr His Phe Asp  
Gly Val Asp Trp Asp Ala Gly Lys Glu Lys Ala Ile Phe Lys Phe Lys Gly Glu Gly Lys Ala Trp  
Asp Trp Glu Val Ser Ser Glu Lys Gly Asn Tyr Asp Tyr Leu Met Tyr Ala Asp Leu Asp Met Asp  
His Gln Glu Val Lys Gln Glu Leu Lys Asp Trp Gly Glu Trp Tyr Ile Asn Met Thr Gly Val Asp Gly  
Phe Arg Met Asp Ala Val Lys His Ile Lys Tyr Gln Tyr Leu Gln Glu Trp Ile Asp His Leu Arg Trp  
Lys Thr Gly Lys Glu Leu Phe Thr Val Gly Glu Tyr Trp Asn Tyr Asp Val Asn Gln Leu His Asn  
Phe Ile Thr Lys Thr Ser Gly Ser Met Ser Leu Phe Asp Ala Pro Leu His Met Asn Phe Tyr Asn Ala  
Ser Lys Ser Gly Gly Asn Tyr Asp Met Arg Gln Ile Met Asn Gly Thr Leu Met Lys Asp Asn Pro Val  
Lys Ala Val Thr Leu Val Glu Asn His Asp Thr Gln Pro Leu Gln Ala Leu Glu Ser Thr Val Asp Trp  
Trp Phe Lys Pro Leu Ala Tyr Ala Phe Ile Leu Leu Arg Glu Glu Gly Tyr Pro Ser Val Phe Tyr Ala  
Asp Tyr Tyr Gly Ala Gln Tyr Ser Asp Lys Gly Tyr Asn Ile Asn Met Ala Lys Val Pro Tyr Ile Glu  
Glu Leu Val Thr Leu Arg Lys Glu Tyr Ala Tyr Gly Lys Gln Asn Ser Tyr Leu Asp His Trp Asp Val  
Ile Gly Trp Thr Arg Glu Gly Asp Ala Glu His Pro Asn Ser Met Ala Val Ile Met Ser Asp Gly Pro  
Gly Gly Lys Lys Trp Met Tyr Thr Gly Lys Pro Ser Thr Arg Tyr Val Asp Lys Leu Gly Ile Arg Thr  
Glu Glu Val Trp Thr Asp Thr Asn Gly Trp Ala Glu Phe Pro Val Asn Gly Gly Ser Val Ser Val Trp  
Val Gly Val Lys

SEQ ID NO: 171

gtgtatgtaaactctttttacgatgcaataaagatggacatggtgatttaaagggtcttacacaaaagtggattatttaaatgatggcaatttcata  
caaagaatgatcttcaagtaaacgggatttgatgatgccggtaacccttctcccagctatcataaataatgatgtaacggactattataattgat  
ccgcaglatggaatctgcaagattttcgaaactgatgaaagaacagataaacgagatgtaaaagtcattatggacctgttgtaatcatatc  
gagcagtgaacaccttggtttcaagctgcattaaaagataaaaacagcaagtagacagattactatatctgggctgataaaaataccgactga  
atgaaaaaggatcttggggacagcaagtagtgataaagccccaaacggagagtagttttacggaacgttttgggaaggaaatgccggacttaa  
ttacgataatcctgaagtaagaaaaaagaaatgattaacgtaggaagttttggctaaagcaaggagttgacgggtccgtctagatgctgcgttca  
tatttttaaaggccaacacctgaaggcgctaagaaaaatctcctgtggtggaatgaatttagagatgcaatgaaaaaggaaaacctaacgtat  
atctaacgggtgaagtagtggaatcaaccggaagtagtagctcttactatcaatcgcttgattctttatttaactttgatttagcaggaaaagattgaa  
actctgtaaaatcaggaaatgatcaaggaatcgcgactgcagcagcggaacggatgaactgttcaaatcatacaatccaataaaattgacgg  
tattttcttaaccaacctgaccaaaatcgcgatcatgagtgagctaagcggcgatgtgaataaagcaagtcagctgcctctatcttacttacgctt  
cctggcaacccgtatatttattacggtgaagaaatcgcatgaccgggtgaaaagcctgatgagttatccgtgaaccgttccgctggtacgaagg  
aaacggacttgacaaaccagctgggaaacacctgtatacaacaaggcggcaacggcgtgtctgtagaagcacaacaaaaacaaaaggac  
tctttgttaaatcattaccgtgaaatgattcgctgcgtcagcagcaggaagagttagtaaaaggaaacgcttcaatctatttcagtagacagtaaag  
aagtcgttgctatagccgcacgtataaaggcaaatcgattagcgtgtatcataatatttcaaatcaaccggtaaaagtagtctagcagcaaaag  
gtaaattgattttgtagtgaagaaagggtgtaagaaagtcaaaatcagcttgattccggcgaatacaacgggtttaataaaaataa

SEQ ID NO: 172

Val Tyr Val Asn Ser Phe Tyr Asp Ala Asn Lys Asp Gly His Gly Asp Leu Lys Gly Leu Thr Gln  
Lys Leu Asp Tyr Leu Asn Asp Gly Asn Ser His Thr Lys Asn Asp Leu Gln Val Asn Gly Ile Trp  
Met Met Pro Val Asn Pro Ser Pro Ser Tyr His Lys Tyr Asp Val Thr Asp Tyr Tyr Asn Ile Asp Pro

Figure 16TTT



Gln Tyr Gly Asn Leu Gln Asp Phe Arg Lys Leu Met Lys Glu Ala Asp Lys Arg Asp Val Lys Val  
Ile Met Asp Leu Val Val Asn His Thr Ser Ser Glu His Pro Trp Phe Gln Ala Ala Leu Lys Asp Lys  
Asn Ser Lys Tyr Arg Asp Tyr Tyr Ile Trp Ala Asp Lys Asn Thr Asp Leu Asn Glu Lys Gly Ser Trp  
Gly Gln Gln Val Trp His Lys Ala Pro Asn Gly Glu Tyr Phe Tyr Gly Thr Phe Trp Glu Gly Met Pro  
Asp Leu Asn Tyr Asp Asn Pro Glu Val Arg Lys Glu Met Ile Asn Val Gly Lys Phe Trp Leu Lys  
Gln Gly Val Asp Gly Phe Arg Leu Asp Ala Ala Leu His Ile Phe Lys Gly Gln Thr Pro Glu Gly Ala  
Lys Lys Asn Leu Leu Trp Trp Asn Glu Phe Arg Asp Ala Met Lys Lys Glu Asn Pro Asn Val Tyr  
Leu Thr Gly Glu Val Trp Asp Gln Pro Glu Val Val Ala Pro Tyr Tyr Gln Ser Leu Asp Ser Leu Phe  
Asn Phe Asp Leu Ala Gly Lys Ile Val Asn Ser Val Lys Ser Gly Asn Asp Gln Gly Ile Ala Thr Ala  
Ala Ala Ala Thr Asp Glu Leu Phe Lys Ser Tyr Asn Pro Asn Lys Ile Asp Gly Ile Phe Leu Thr Asn  
His Asp Gln Asn Arg Val Met Ser Glu Leu Ser Gly Asp Val Asn Lys Ala Lys Ser Ala Ala Ser Ile  
Leu Leu Thr Leu Pro Gly Asn Pro Tyr Ile Tyr Tyr Gly Glu Glu Ile Gly Met Thr Gly Glu Lys Pro  
Asp Glu Leu Ile Arg Glu Pro Phe Arg Trp Tyr Glu Gly Asn Gly Leu Gly Gln Thr Ser Trp Glu Thr  
Pro Val Tyr Asn Lys Gly Gly Asn Gly Val Ser Val Glu Ala Gln Thr Lys Gln Lys Asp Ser Leu Leu  
Asn His Tyr Arg Glu Met Ile Arg Val Arg Gln Gln His Glu Glu Leu Val Lys Gly Thr Leu Gln Ser  
Ile Ser Val Asp Ser Lys Glu Val Val Ala Tyr Ser Arg Thr Tyr Lys Gly Lys Ser Ile Ser Val Tyr His  
Asn Ile Ser Asn Gln Pro Val Lys Val Ser Val Ala Ala Lys Gly Lys Leu Ile Phe Gly Ser Glu Lys  
Gly Ala Lys Lys Val Lys Asn Gln Leu Val Ile Pro Ala Asn Thr Thr Val Leu Ile Lys

SEQ ID NO: 173

atgcaaacgattgcaaaaaaaggggatgaaacgatgaaagggaataatggacagcttagctctaactgccgctggctgctagcttatca  
acaggcgttcacgcagaaactgtacataaaggtaaaagctccaacagcagataaaaacgggtgttttatgaggtgtatgaaactcttttacgatg  
caataaagatggacatggtgattaaaaggctgacacaaaagtggtattttaaatgacggcaattctcatacaagaatgatcttcaagtaaa  
cgggatttggatgatgccggtaaacccttctcctagctatcataaatatgatgaacggactattataacattgatcctcagtagcgaagtctgcaa  
gatttccgcaaacgtgatgaaagaacagataaacgagacgtaaaagtattatggaccttgttgaatcatacagcagtagaacaccccttggtt  
caagctgcactaaaagataaaaacagcaagtagacagattactatatttggcgtgataaaaataccgatttgaatgaaaaggatcttggggaca  
gcaagtatggcataaagctccaacggagagtattttacggaacgttctgggaagggaatgcctgacttaattacgataaacctgaagtaagaa  
aagaaatgattaacgtcggaaagtgttggttaaagcaaggcgttgatggctccgcttagatgctgcccttcatactttaaaggtaaacctctga  
aggcgttaagaaaaatctcctgtgttggaatgagtttagatgcaatgaaaaagaaaaaccctaactatataacgggtgaagtatgggat  
cagccggaagtagtagctccttattatcaatcgcttgattccctatttaactttgatttagcaggaaaaattgtcagctctgtaaaagcaggaaatgat  
caaggaatgccactgcagcagcggaacggatgagctgttcaatcatacaatccaaataaaattgacggcattttctaaccaaacatgacca  
aaaccgcgtcatgagtgaagcggagatgtgaataaagcaaaatcagctgcttcttacttacgcttctggaaatccgtaattatttacg  
gtgaagaattggcatgaccggtgaaaagcctgatgaatattccgtgaaccgttccgctgttacgaaggcaacggaattggacaaactagct  
gggaaacacctgtatatacaaaaggcggaatggtgtgtctgtagaagcacaacaaacaaaaggattctttgtaaatcattaccgtgaaatg  
attcgcgtgcgtcagcagcaagaagtagtaaaaggaacgcttcagctatttcagtagacagtaaaagaagttgtcgttatagccgtacgtat  
aaaggcaactccattagtgtgtatcataatatttcaaatcaacctgtaaaagtatctgtagcggcgaaaggtaaatgattttgctagtgtgaaaagg  
tgctaaaaaaggcaaaatcagcttgattccggcggaatgcgacgggtttaataaaataa

SEQ ID NO: 174

Met Gln Thr Ile Ala Lys Lys Gly Asp Glu Thr Met Lys Gly Lys Lys Trp Thr Ala Leu Ala Leu Thr  
Leu Pro Leu Ala Ala Ser Leu Ser Thr Gly Val His Ala Glu Thr Val His Lys Gly Lys Ala Pro Thr  
Ala Asp Lys Asn Gly Val Phe Tyr Glu Val Tyr Val Asn Ser Phe Tyr Asp Ala Asn Lys Asp Gly His  
Gly Asp Leu Lys Gly Leu Thr Gln Lys Leu Asp Tyr Leu Asn Asp Gly Asn Ser His Thr Lys Asn  
Asp Leu Gln Val Asn Gly Ile Trp Met Met Pro Val Asn Pro Ser Pro Ser Tyr His Lys Tyr Asp Val  
Thr Asp Tyr Tyr Asn Ile Asp Pro Gln Tyr Gly Ser Leu Gln Asp Phe Arg Lys Leu Met Lys Glu Ala  
Asp Lys Arg Asp Val Lys Val Ile Met Asp Leu Val Val Asn His Thr Ser Ser Glu His Pro Trp Phe  
Gln Ala Ala Leu Lys Asp Lys Asn Ser Lys Tyr Arg Asp Tyr Tyr Ile Trp Ala Asp Lys Asn Thr Asp  
Leu Asn Glu Lys Gly Ser Trp Gly Gln Gln Val Trp His Lys Ala Pro Asn Gly Glu Tyr Phe Tyr Gly  
Thr Phe Trp Glu Gly Met Pro Asp Leu Asn Tyr Asp Asn Pro Glu Val Arg Lys Glu Met Ile Asn Val  
Gly Lys Phe Trp Leu Lys Gln Gly Val Asp Gly Phe Arg Leu Asp Ala Ala Leu His Ile Phe Lys Gly



Figure 16UUU

Gln Thr Pro Glu Gly Ala Lys Lys Asn Leu Leu Trp Trp Asn Glu Phe Arg Asp Ala Met Lys Lys  
Glu Asn Pro Asn Val Tyr Leu Thr Gly Glu Val Trp Asp Gln Pro Glu Val Val Ala Pro Tyr Tyr Gln  
Ser Leu Asp Ser Leu Phe Asn Phe Asp Leu Ala Gly Lys Ile Val Ser Ser Val Lys Ala Gly Asn Asp  
Gln Gly Ile Ala Thr Ala Ala Ala Thr Asp Glu Leu Phe Lys Ser Tyr Asn Pro Asn Lys Ile Asp  
Gly Ile Phe Leu Thr Asn His Asp Gln Asn Arg Val Met Ser Glu Leu Ser Gly Asp Val Asn Lys Ala  
Lys Ser Ala Ala Ser Ile Leu Leu Thr Leu Pro Gly Asn Pro Tyr Ile Tyr Tyr Gly Glu Glu Ile Gly Met  
Thr Gly Glu Lys Pro Asp Glu Leu Ile Arg Glu Pro Phe Arg Trp Tyr Glu Gly Asn Gly Ile Gly Gln  
Thr Ser Trp Glu Thr Pro Val Tyr Asn Lys Gly Gly Asn Gly Val Ser Val Glu Ala Gln Thr Lys Gln  
Lys Asp Ser Leu Leu Asn His Tyr Arg Glu Met Ile Arg Val Arg Gln Gln His Glu Glu Leu Val Lys  
Gly Thr Leu Gln Ser Ile Ser Val Asp Ser Lys Glu Val Val Ala Tyr Ser Arg Thr Tyr Lys Gly Asn  
Ser Ile Ser Val Tyr His Asn Ile Ser Asn Gln Pro Val Lys Val Ser Val Ala Ala Lys Gly Lys Leu Ile  
Phe Ala Ser Glu Lys Gly Ala Lys Lys Gly Lys Asn Gln Leu Val Ile Pro Ala Asn Ala Thr Val Leu  
Ile Lys

SEQ ID NO: 175

atgaaaaatataatcacgactttgtgctgccagcgctatcctcacgggtgtcccacgccagttacgccgacgcaattttacacgcgtttaactggcaat  
ataccgatgaaccgcaatgcaaatcaaatgccgcaaatggctttaaaaagtcctcatcaccgcaatgaaatccagcggcagtcgaatgg  
tgggcccgtatcaaccgcaagacttgcgtgtcattgattctccgtgggcaacaagaatttagtcgcgatgatcaatgcgctcaacagcgt  
tggggtcgacgtgtatgctgacgtgggtgcttaaccatattgctaacgagtcagtggaagcgcagtgacctaactccggggagtgagggtgt  
caacgactatcaatcccgcagtgcttactatcaaaggcaaacacttttcggcaatttacaggagaacctttttccgagaatgattccatccggca  
ggcgtgtattaccaattggaatgatcctggccacgtccagttatggcgctgtgtgcccggacagggcgatactgggctaccggatctcgcaccta  
tcaatgggtgtgagtcagcagaagagttacttgaacgcactcaaatcaatgggaatcaaagggtccgtatcgatcggtgcaaacatagagtc  
aatatcaaatagaccaagtgtttaccccagacattaccgctggtatgcataattcggagaagtcattaccagtggtgggcaagggtgatagcggt  
atgaggcttttctgccccttacctaataataccgatcacgccgcttatgactccccgctatttgcacgattcgagccgcgttttcattctctggtgg  
gttaaatcagctacacaatccacaagcctatggccaagcgttacaggactcacgtgcgatcacctttacgattaccacgacattccaaccaatg  
acggtttccgctaccagatcatggatccaaccgatgaacagctcgcctatgcctacatcttgggcaaatgaggaacgccactgtctatagt  
gatgacctacgtgacagcgaagacaaagacagtggtcgttgggcccgatgtgtggcaagatccgaacatgattaacatgcttgcctccacaacg  
cgatgcaaggacaaagcatgactgtagtggctagcgatcaatgtacttgcctttaaagcgcggcaagcaaggcgtggttagaatcaataatg  
tggcgagagtaagtcggtgactgtcgatactaccagcatgagtttaactgggtacaccccggtaccaagacgtattgagcggcgacatcaccaca  
gtgagttctcgttatcacaattgttttgccagcgcgcagtgcaaggatgtggaaactataa

SEQ ID NO: 176

Met Lys Asn Ile Ile Arg Leu Cys Ala Ala Ser Ala Ile Leu Thr Val Ser His Ala Ser Tyr Ala Asp Ala  
Ile Leu His Ala Phe Asn Trp Gln Tyr Thr Asp Val Thr Ala Asn Ala Asn Gln Ile Ala Ala Asn Gly  
Phe Lys Lys Val Leu Ile Ser Pro Ala Met Lys Ser Ser Gly Ser Gln Trp Trp Ala Arg Tyr Gln Pro  
Gln Asp Leu Arg Val Ile Asp Ser Pro Leu Gly Asn Lys Gln Asp Leu Val Ala Met Ile Asn Ala Leu  
Asn Ser Val Gly Val Asp Val Tyr Ala Asp Val Val Leu Asn His Met Ala Asn Glu Ser Trp Lys Arg  
Ser Asp Leu Asn Tyr Pro Gly Ser Glu Val Leu Asn Asp Tyr Gln Ser Arg Ser Ala Tyr Tyr Gln Arg  
Gln Thr Leu Phe Gly Asn Leu Gln Glu Asn Leu Phe Ser Glu Asn Asp Phe His Pro Ala Gly Cys Ile  
Thr Asn Trp Asn Asp Pro Gly His Val Gln Tyr Trp Arg Leu Cys Gly Gly Gln Gly Asp Thr Gly  
Leu Pro Asp Leu Asp Pro Asn Gln Trp Val Val Ser Gln Gln Lys Ser Tyr Leu Asn Ala Leu Lys Ser  
Met Gly Ile Lys Gly Phe Arg Ile Asp Ala Val Lys His Met Ser Gln Tyr Gln Ile Asp Gln Val Phe  
Thr Pro Asp Ile Thr Ala Gly Met His Ile Phe Gly Glu Val Ile Thr Ser Gly Gly Gln Gly Asp Ser Gly  
Tyr Glu Ala Phe Leu Ala Pro Tyr Leu Asn Asn Thr Asp His Ala Ala Tyr Asp Phe Pro Leu Phe Ala  
Ser Ile Arg Ala Ala Phe Ser Phe Ser Gly Gly Leu Asn Gln Leu His Asn Pro Gln Ala Tyr Gly Gln  
Ala Leu Gln Asp Ser Arg Ala Ile Thr Phe Thr Ile Thr His Asp Ile Pro Thr Asn Asp Gly Phe Arg  
Tyr Gln Ile Met Asp Pro Thr Asp Glu Gln Leu Ala Tyr Ala Tyr Ile Leu Gly Lys Asp Gly Gly Thr  
Pro Leu Val Tyr Ser Asp Thr Asp Pro Asn Ser Glu Asp Lys Asp Ser Gly Arg Trp Ala Asp Val Trp  
Gln Asp Pro Asn Met Ile Asn Met Leu Ala Phe His Asn Ala Met Gln Gly Gln Ser Met Thr Val Val  
Ala Ser Asp Gln Cys Thr Leu Leu Phe Lys Arg Gly Lys Gln Gly Val Val Gly Ile Asn Lys Cys Gly



Figure 16VVV

Glu Ser Lys Ser Val Thr Val Asp Thr Tyr Gln His Glu Phe Asn Trp Tyr Thr Pro Tyr Gln Asp Val  
Leu Ser Gly Asp Ile Thr Thr Val Ser Ser Arg Tyr His Gln Phe Val Leu Pro Ala Arg Ser Ala Arg  
Met Trp Lys Leu

SEQ ID NO: 177

atgaaaacattcaaatfaaacgcactttttaccgctgaccttgctgctcagtgctccttgctgggcaaaatggcaccatgatgcagtatttt  
cattggtacgtacctaataatgatggcgacattatggacgcaggttgaaagcaatgctccagctactcgtgaaaacgggttttacagcgtctggtacc  
gcccgcatacaaaaggcgccggcgccagtaataatgacgtcggttatggcgctatgatatgtacgatttaggtgagttgacaaaaaggctcagta  
cgaacaaatacggcaccgaaggctcagtaacatctctgaatcaatgccgcgcacacaacaataatccaaattacggcgacgttggtttaacca  
ccgaggtggcgctgatgggaagtcgtgggtcgataccaagcgcttgattgggacaaccgcaatattgaactggcgacaaatggattgaag  
cttgggttgagtttaatttctggccgcaacgacaaatactgaacttccattggacttggtatcactttgacgggttgactgggatgatgccggc  
aaagaaaaagcgatctttaaatcaaaaggcggaaggaaagcatgggattgggaagtcagctctgaaaaaggcaattacgactacctaattgtac  
gccgatttagacatggatcacccagaagttaaacaagagctgaaagattgggggtgagtggtacatcaacatgaccggcggttgatggcttagaa  
tggtatgccgtgaagcacattaaatatcagtatctacaagagtggtatgatcattacgttggaacacaggcgaagagctttaccggttggtgagta  
ttggaattacgacgtaataactgcacaactttattactaagacctctggcagtatgtcgttggtgatgcgccgcttcacatgaattctacaacgc  
gtcaaaatctggcgacattacgatatgcgccaatcatgaatggcacgttgatgaaggacaacccagtcgaagcagtgactctcgtagaaaac  
cacgatacgcagccattgcagcggttagagtcgacagtagattgggtggttcaagcctcttgcttacgcattcattttattgcgtgaagaaggttatc  
catcggtgttctacgcagattactacggcgcgagtcacgcagacaaggttacaacattaatatggccaaagtccttacattgaagaacttgtaa  
cactgcgtaaaagagtatcgctatggcaaacagaattcttatctcgaccattgggatgtgattggctggaccgagagggcgatgctgaacatcc  
aaactcaatggcggtgatcatgatggaccggcgccacaaaatggatgtataccggtaagccaagtacgcgctatgtcgacaagctgg  
gtatccgaactgaagatgtttggaccgatgccaatggctgggcagaatttctgtcaatgggtggttcagtcctcggttgggtggcggttaagtaa

SEQ ID NO: 178

Met Lys Thr Phe Lys Leu Lys Arg Thr Phe Leu Pro Leu Thr Leu Leu Ser Ala Pro Ala Phe Ala  
Gly Gln Asn Gly Thr Met Met Gln Tyr Phe His Trp Tyr Val Pro Asn Asp Gly Ala Leu Trp Thr Gln  
Val Glu Ser Asn Ala Pro Val Leu Ala Glu Asn Gly Phe Thr Ala Leu Trp Leu Pro Pro Ala Tyr Lys  
Gly Ala Gly Gly Ser Asn Asp Val Gly Tyr Gly Val Tyr Asp Met Tyr Asp Leu Gly Glu Phe Asp  
Gln Lys Gly Ser Val Arg Thr Lys Tyr Gly Thr Lys Ala Gln Tyr Ile Ser Ala Ile Asn Ala Ala His  
Asn Asn Asn Ile Gln Ile Tyr Gly Asp Val Val Phe Asn His Arg Gly Gly Ala Asp Gly Lys Ser Trp  
Val Asp Thr Lys Arg Val Asp Trp Asp Asn Arg Asn Ile Glu Leu Gly Asp Lys Trp Ile Glu Ala Trp  
Val Glu Phe Asn Phe Pro Gly Arg Asn Asp Lys Tyr Ser Asn Phe His Trp Thr Trp Tyr His Phe Asp  
Gly Val Asp Trp Asp Ala Gly Lys Glu Lys Ala Ile Phe Lys Phe Lys Gly Glu Gly Lys Ala Trp  
Asp Trp Glu Val Ser Ser Glu Lys Gly Asn Tyr Asp Tyr Leu Met Tyr Ala Asp Leu Asp Met Asp  
His Pro Glu Val Lys Gln Glu Leu Lys Asp Trp Gly Glu Trp Tyr Ile Asn Met Thr Gly Val Asp Gly  
Phe Arg Met Asp Ala Val Lys His Ile Lys Tyr Gln Tyr Leu Gln Glu Trp Ile Asp His Leu Arg Trp  
Lys Thr Gly Lys Glu Leu Phe Thr Val Gly Glu Tyr Trp Asn Tyr Asp Val Asn Gln Leu His Asn  
Phe Ile Thr Lys Thr Ser Gly Ser Met Ser Leu Phe Asp Ala Pro Leu His Met Asn Phe Tyr Asn Ala  
Ser Lys Ser Gly Gly Thr Tyr Asp Met Arg Gln Ile Met Asn Gly Thr Leu Met Lys Asp Asn Pro Val  
Lys Ala Val Thr Leu Val Glu Asn His Asp Thr Gln Pro Leu Gln Ala Leu Glu Ser Thr Val Asp Trp  
Trp Phe Lys Pro Leu Ala Tyr Ala Phe Ile Leu Leu Arg Glu Glu Gly Tyr Pro Ser Val Phe Tyr Ala  
Asp Tyr Tyr Gly Ala Gln Tyr Ser Asp Lys Gly Tyr Asn Ile Asn Met Ala Lys Val Pro Tyr Ile Glu  
Glu Leu Val Thr Leu Arg Lys Glu Tyr Ala Tyr Gly Lys Gln Asn Ser Tyr Leu Asp His Trp Asp Val  
Ile Gly Trp Thr Arg Glu Gly Asp Ala Glu His Pro Asn Ser Met Ala Val Ile Met Ser Asp Gly Pro  
Gly Gly Thr Lys Trp Met Tyr Thr Gly Lys Pro Ser Thr Arg Tyr Val Asp Lys Leu Gly Ile Arg Thr  
Glu Asp Val Trp Thr Asp Ala Asn Gly Trp Ala Glu Phe Pro Val Asn Gly Gly Ser Val Ser Val Trp  
Val Gly Val Lys

SEQ ID NO: 179

atgaaaacattcaaatfaaacgcactttttaccgctaacttgctgctcagtgctccttgctgggcaaaatggcaccatgatgcagtactt  
tcattggtacgtacctaataatgatggcgacattatggacgcaggttgaaagcaatgctccagcactcgtgaaaacgggttttacagcgtctggtacc



Figure 16WWW

gccagcttacaaggcgcgggcgggcagta.tgatgtcggttatggcgctctacgatatgtacgatttaggtgagttgatcaaaaaggctcagtac  
gaaccaatacggtagcaaggctcagtagatctctgcaatcaatgctgcgcacaacaacaatatccaaatttaccggcgacgttggtttaaccatc  
gtggtggcgctgatgggaagtcgtgggtcgataccaagcggttgattgggacaaccgtaacattgaactggcgacaaatggattgaagctt  
gggttgagtttaattttctagccgcaacgacaaatactgaacttccattggacttggtatcactttgacgggtgtgactgggatgatccggcaa  
agaaaaagcgatctttaattcaaaaggcgaaggaaaaagcatgggattgggaagtcagctctgaaaaaggcaattacgactacctaattgtacgc  
cgatttagacatggatcacccagaagttaaacaagagctgaaagattgggtgagtggtacatcaacatgaccggcggttgatggctttagaatg  
gatgccgttaagcacattaaatatcagtagtctacaagagtggttgatcatttaccgttgaaaacaggcaaaagagcttttaccgttggtgagtattg  
gaattacgacgtaaatcaactgcataactttattactaagacctctggcagtagtgcgttgctgatgcgccgcttccatgaactctacaacgcgt  
caaaatctggcggaattacgatatgcgcaaatcatgaatggcacgttgatgaaggacaacccagtcgaaagctgtgactctctagaaaacca  
cgatacgagccattgcaggcgtagagtcgacagtggttggttgcaagcctcttgcttaccgattcatctgttgctgaagaagggttatcca  
tcggtgtctacgcagattactacggcgcgagtagcagcgacaaaggttacaacattaatatggccaaagtccttaccattgaagaacttgtaaca  
ctgcgtaaagagtagtgcgtatggcaaacagaattcttatctcgaccattgggatgtgattggctggactcgagaggcgatgctgaacatccaaa  
ctcaatggcggtgatcatgagtgatggaccggcggaacaaaatggatgtataccggtaatccaagcacgcgtatgtcgacaagctgggtat  
ccgaactgaagatgttggaccgatgccaatggctggcgagaatttctgcaatgggtggtcagtcctcggttgggtggcggttaagtaa

SEQ ID NO: 180

Met Lys Thr Phe Lys Leu Lys Arg Thr Phe Leu Pro Leu Thr Leu Leu Ser Ala Pro Ala Phe Ala  
Gly Gln Asn Gly Thr Met Met Gln Tyr Phe His Trp Tyr Val Pro Asn Asp Gly Ala Leu Trp Thr Gln  
Val Glu Ser Asn Ala Pro Ala Leu Ala Glu Asn Gly Phe Thr Ala Leu Trp Leu Pro Pro Ala Tyr Lys  
Gly Ala Gly Gly Ser Asn Asp Val Gly Tyr Gly Val Tyr Asp Met Tyr Asp Leu Gly Glu Phe Asp  
Gln Lys Gly Ser Val Arg Thr Lys Tyr Gly Thr Lys Ala Gln Tyr Ile Ser Ala Ile Asn Ala Ala His  
Asn Asn Asn Ile Gln Ile Tyr Gly Asp Val Val Phe Asn His Arg Gly Gly Ala Asp Gly Lys Ser Trp  
Val Asp Thr Lys Arg Val Asp Trp Asp Asn Arg Asn Ile Glu Leu Gly Asp Lys Trp Ile Glu Ala Trp  
Val Glu Phe Asn Phe Pro Ser Arg Asn Asp Lys Tyr Ser Asn Phe His Trp Thr Trp Tyr His Phe Asp  
Gly Val Asp Trp Asp Ala Gly Lys Glu Lys Ala Ile Phe Lys Phe Lys Gly Glu Gly Lys Ala Trp  
Asp Trp Glu Val Ser Ser Glu Lys Gly Asn Tyr Asp Tyr Leu Met Tyr Ala Asp Leu Asp Met Asp  
His Pro Glu Val Lys Gln Glu Leu Lys Asp Trp Gly Glu Trp Tyr Ile Asn Met Thr Gly Val Asp Gly  
Phe Arg Met Asp Ala Val Lys His Ile Lys Tyr Gln Tyr Leu Gln Glu Trp Ile Asp His Leu Arg Trp  
Lys Thr Gly Lys Glu Leu Phe Thr Val Gly Glu Tyr Trp Asn Tyr Asp Val Asn Gln Leu His Asn  
Phe Ile Thr Lys Thr Ser Gly Ser Met Ser Leu Phe Asp Ala Pro Leu His Met Asn Phe Tyr Asn Ala  
Ser Lys Ser Gly Gly Asn Tyr Asp Met Arg Gln Ile Met Asn Gly Thr Leu Met Lys Asp Asn Pro Val  
Lys Ala Val Thr Leu Val Glu Asn His Asp Thr Gln Pro Leu Gln Ala Leu Glu Ser Thr Val Asp Trp  
Trp Phe Lys Pro Leu Ala Tyr Ala Phe Ile Leu Leu Arg Glu Glu Gly Tyr Pro Ser Val Phe Tyr Ala  
Asp Tyr Tyr Gly Ala Gln Tyr Ser Asp Lys Gly Tyr Asn Ile Asn Met Ala Lys Val Pro Tyr Ile Glu  
Glu Leu Val Thr Leu Arg Lys Glu Tyr Ala Tyr Gly Lys Gln Asn Ser Tyr Leu Asp His Trp Asp Val  
Ile Gly Trp Thr Arg Glu Gly Asp Ala Glu His Pro Asn Ser Met Ala Val Ile Met Ser Asp Gly Pro  
Gly Gly Thr Lys Trp Met Tyr Thr Gly Asn Pro Ser Thr Arg Tyr Val Asp Lys Leu Gly Ile Arg Thr  
Glu Asp Val Trp Thr Asp Ala Asn Gly Trp Ala Glu Phe Pro Val Asn Gly Gly Ser Val Ser Val Trp  
Val Gly Val Lys

SEQ ID NO: 181

ttgcagaggcctcggcctggccattacgccgtcacatagccggcgggggaggttggtggcggtgcgcgccccggcgagcctgccgatgc  
cggtctccactggcgccggttcacccctcgtccggcgcttcgtcgccgggtcatccgaacaagcacaagaaccggagtattcgatgaccaca  
ccctcgtgcgccgctgctggcgatcctgctgcgttccccgccctcgtgaccaggcggaagagccccggcggtgcgtaccca  
cggcggcgacgaaatcatctccagggttccactggaacgtgtccgcgaagcgccaacgactggtacaacatcttccagcaggcct  
cgacgatcgccgcggacggcttctcggaatctggatgccgttgccctggcgtgacttctccagctggaccgacggcggaagtcaggcgg  
cggcgaaggctacttctggcacgacttcaacaagaacggcgctacggcgacgcagccagctgcgccaggccggcgccgactcgggtg  
cgccgggtgaagggtgctctacgatgtggtgcccaatcacatgaaccgggctatccggacaaggagatcaacctgccggcgccaggcc  
ttctgpcgaacgactgcaccgaccggcgaactacccaacgactgcgatgacgggtgaccgttcatcgccggcaagtcggacctgaaca  
ccggccatccgcagatctacggcatgttctcgacgagcttgccaacctgcgcagcgggtacggcgccggcggttccgctcactcgtt

Figure 16XXX



Applicant(s): Walter Callen et al.  
ENZYMES HAVING ALPHA AMYLASE ACTIVITY AND  
METHODS OF USE THEREOF

gcggctatgcgcccgaacgggtcgacagctggatgagcgacagcgccgacagcagtttctgcgttggcgagctgtggaaaagcccgtccga  
gtacccgagctgggactggcgcaacacggcgagctggcagcagatcatcaaggactggtccgaccgggccaagtccccgtgttcgacttc  
gcgctcaaggagcgcatgcagaacggctcggtcgccgactggaagcatggcctcaatggcaacccggaccgcgctggcgcgaggtggc  
ggtgacctttgtcgacaaccacgacaccggctattcgccgggcaaacggcgccagcaccactgggcgctgcaggacgggctgatccg  
ccaggcctacgcctacatcctcaccagcccgggcacgccgggtggtgtactggtcgacatgtacgactggggctacggcgacttcattcgcca  
gctgatccagggtgcgggcgaccgctggcggtgcgcggcattcgccgatcagcttccacagcggtacagcggcctggtcgctaccgtcagc  
ggcagccatcagaccctggtggtggcgctcaactccgatctggccaacccggccaggctgccagcggcagcttcagcgaggcggtcaac  
gccagcaacggccagggtgcgcgtctggcgagcggtagcgggcgatggcgggcggaatgacggcggcgagggcggtctggtcaatgtgaa  
cttcgctgcgacaacggcggtgacgcagatggggcgacagcgctacgcgggtgggcaacgctcagccagctcggaactggagcccggcctc  
cgcggtacgggtgacgcacaccagcagctatccgacctggaagggcagcatcgccctgcctgacggtcagaacgtggaatggaagtgcctg  
atccgtaacgagggcgacgcgacgctggtgcgccagtggcaatcggcggaacaaccaggctccaggccgctgccggcgagcaccac  
cgggctcgttctga

SEQ ID NO: 182

Met Pro Glu Ala Phe Gly Leu Ala Ile Thr Pro Ser His Ser Arg Arg Gly Arg Leu Val Gly Val Ser  
Arg Gly Gly Ser Leu Pro Met Pro Val Leu His Trp Pro Ala Phe Ile Leu Val Arg Arg Phe Val Ala  
Gly His Pro Asn Lys His Lys Asn Arg Ser Ile Ala Met Ser His Thr Leu Arg Ala Ala Val Leu Ala  
Ala Ile Leu Leu Pro Phe Pro Ala Leu Ala Asp Gln Ala Gly Lys Ser Pro Ala Gly Val Arg Tyr His  
Gly Gly Asp Glu Ile Ile Leu Gln Gly Phe His Trp Asn Val Val Arg Glu Ala Pro Asn Asp Trp Tyr  
Asn Ile Leu Arg Gln Gln Ala Ser Thr Ile Ala Ala Asp Gly Phe Ser Ala Ile Trp Met Pro Val Pro Trp  
Arg Asp Phe Ser Ser Trp Thr Asp Gly Gly Lys Ser Gly Gly Gly Glu Gly Tyr Phe Trp His Asp Phe  
Asn Lys Asn Gly Arg Tyr Gly Ser Asp Ala Gln Leu Arg Gln Ala Ala Gly Ala Leu Gly Gly Ala  
Gly Val Lys Val Leu Tyr Asp Val Val Pro Asn His Met Asn Arg Gly Tyr Pro Asp Lys Glu Ile Asn  
Leu Pro Ala Gly Gln Gly Phe Trp Arg Asn Asp Cys Thr Asp Pro Gly Asn Tyr Pro Asn Asp Cys  
Asp Asp Gly Asp Arg Phe Ile Gly Gly Lys Ser Asp Leu Asn Thr Gly His Pro Gln Ile Tyr Gly Met  
Phe Arg Asp Glu Leu Ala Asn Leu Arg Ser Gly Tyr Gly Ala Gly Gly Phe Arg Phe Asp Phe Val  
Arg Gly Tyr Ala Pro Glu Arg Val Asp Ser Trp Met Ser Asp Ser Ala Asp Ser Ser Phe Cys Val Gly  
Glu Leu Trp Lys Ser Pro Ser Glu Tyr Pro Ser Trp Asp Trp Arg Asn Thr Ala Ser Trp Gln Gln Ile Ile  
Lys Asp Trp Ser Asp Arg Ala Lys Cys Pro Val Phe Asp Phe Ala Leu Lys Glu Arg Met Gln Asn  
Gly Ser Val Ala Asp Trp Lys His Gly Leu Asn Gly Asn Pro Asp Pro Arg Trp Arg Glu Val Ala Val  
Thr Phe Val Asp Asn His Asp Thr Gly Tyr Ser Pro Gly Gln Asn Gly Gly Gln His His Trp Ala Leu  
Gln Asp Gly Leu Ile Arg Gln Ala Tyr Ala Tyr Ile Leu Thr Ser Pro Gly Thr Pro Val Val Tyr Trp Ser  
His Met Tyr Asp Trp Gly Tyr Gly Asp Phe Ile Arg Gln Leu Ile Gln Val Arg Arg Thr Ala Gly Val  
Arg Ala Asp Ser Ala Ile Ser Phe His Ser Gly Tyr Ser Gly Leu Val Ala Thr Val Ser Gly Ser His Gln  
Thr Leu Val Val Ala Leu Asn Ser Asp Leu Ala Asn Pro Gly Gln Val Ala Ser Gly Ser Phe Ser Glu  
Ala Val Asn Ala Ser Asn Gly Gln Val Arg Val Trp Arg Ser Gly Ser Gly Asp Gly Gly Gly Asn Asp  
Gly Gly Glu Gly Gly Leu Val Asn Val Asn Phe Arg Cys Asp Asn Gly Val Thr Gln Met Gly Asp  
Ser Val Tyr Ala Val Gly Asn Val Ser Gln Leu Gly Asn Trp Ser Pro Ala Ser Ala Val Arg Leu Thr  
Asp Thr Ser Ser Tyr Pro Thr Trp Lys Gly Ser Ile Ala Leu Pro Asp Gly Gln Asn Val Glu Trp Lys  
Cys Leu Ile Arg Asn Glu Ala Asp Ala Thr Leu Val Arg Gln Trp Gln Ser Gly Gly Asn Asn Gln Val  
Gln Ala Ala Ala Gly Ala Ser Thr Ser Gly Ser Phe

SEQ ID NO: 183

atgcaaacgattgcaaaaaaggggatgaaacgatgaaagggaataatggacagcttagcttaacactgccgctggctgtagcttatca  
acaggcgttcacgccgaaccgtacataaaggtaagtctgaagcaacagataaaaaacgggtgtctttatgagggtgatgaaactcttttacgata  
caataaagatggacatggtgatttaaaggctcgacacaaaagttggattttaaataacgacggcaattctcatacaaaagaatgatcttcaagtaaa  
cgggatttgatgcccagtcacaccttctcctagctatcataaataatgatgtaacggactattataacattgatcctcagtagcgaatctgcaag  
atttcgcaagctgatgaaagaagcagacaaacgagacgtaaaagtcattatggacctgtgtgtaatcatacagcagcgaacaccccttggttt  
caagctgcattaaagaataaagcaagtagcagattactatatttgggctgataaaaaatccgattgaaatgaaaaggatcttgggggca  
gcaagtatggcataaagctccaaacggagagatttttacggaacgttttgggaaggaaatgcctgacttaaattacgataaacctgaagtaagaa

Figure 16YYY



Applicant(s): Walter Callen et al.  
ENZYMES HAVING ALPHA AMYLASE ACTIVITY AND  
METHODS OF USE THEREOF

aagaaatgattaacgtcggaaagtttggctaaagcaaggcggttaatggcttcgctagatgctgcgttcataattttaagggtcaaacacctga  
aggcgctaagaaaaatatctgtggtggaatgagtttagagatgcgatgaaaaagaaaaccctaactatatacgggtgaagtagggat  
cagcctgaagtgtagctccttactatcaatcgcttgattctttatattttgatttagcaggaaaaattgtcagctctgtaaaagcaggaaatgatc  
aaggaaatcgccactgcagcagcggcaacagatgaactgttcaaatcatacaatccaaataaaattgacggcattttcttaaccaacatgacca  
aatcgctcatgagtgagctgagcggcgatgtgaacaaagcaaaatcagctgcttctacttactacgcttctggaacccgtatatttattacg  
gtgaagaaattggcatgaccgggtgaaaagcctgatgagtaatccgtgaaccattccgctggtacgaaggaaacggacttggacaaactagct  
gggaaacacctgtatataacaaaggcggcaacggcgtgtctgtagaagtacaaacaaacaaaaggattcttggtaaatcattatcgtgaaatg  
attcgctgctgcagcagcatgaagagtagtaaaaggaacgcttcaatctatttcagtagacagtaaaagagtggttgcctatagtcgcacgtat  
aaaggcaactcgattagcgtgtatcataatatttcaaatcaacctgtaaaagtatctgtagcagcgaaaggtaaattgattttgctagtgaaaaagg  
tgctaaaaaagtcaaaaatcagcttgaattccggctaatacaacgggtttaataaaaataa

SEQ ID NO: 184

Met Gln Thr Ile Ala Lys Lys Gly Asp Glu Thr Met Lys Gly Lys Lys Trp Thr Ala Leu Ala Leu Thr  
Leu Pro Leu Ala Ala Ser Leu Ser Thr Gly Val His Ala Glu Thr Val His Lys Gly Lys Ser Glu Ala  
Thr Asp Lys Asn Gly Val Phe Tyr Glu Val Tyr Val Asn Ser Phe Tyr Asp Thr Asn Lys Asp Gly His  
Gly Asp Leu Lys Gly Leu Thr Gln Lys Leu Asp Tyr Leu Asn Asp Gly Asn Ser His Thr Lys Asn  
Asp Leu Gln Val Asn Gly Ile Trp Met Met Pro Val Asn Pro Ser Pro Ser Tyr His Lys Tyr Asp Val  
Thr Asp Tyr Tyr Asn Ile Asp Pro Gln Tyr Gly Asn Leu Gln Asp Phe Arg Lys Leu Met Lys Glu Ala  
Asp Lys Arg Asp Val Lys Val Ile Met Asp Leu Val Val Asn His Thr Ser Ser Glu His Pro Trp Phe  
Gln Ala Ala Leu Lys Asp Lys Asn Ser Lys Tyr Arg Asp Tyr Tyr Ile Trp Ala Asp Lys Asn Thr Asp  
Leu Asn Glu Lys Gly Ser Trp Gly Gln Gln Val Trp His Lys Ala Pro Asn Gly Glu Tyr Phe Tyr Gly  
Thr Phe Trp Glu Gly Met Pro Asp Leu Asn Tyr Asp Asn Pro Glu Val Arg Lys Glu Met Ile Asn Val  
Gly Lys Phe Trp Leu Lys Gln Gly Val Asn Gly Phe Arg Leu Asp Ala Ala Leu His Ile Phe Lys Gly  
Gln Thr Pro Glu Gly Ala Lys Lys Asn Ile Leu Trp Trp Asn Glu Phe Arg Asp Ala Met Lys Lys Glu  
Asn Pro Asn Val Tyr Leu Thr Gly Glu Val Trp Asp Gln Pro Glu Val Val Ala Pro Tyr Tyr Gln Ser  
Leu Asp Ser Leu Phe Asn Phe Asp Leu Ala Gly Lys Ile Val Ser Ser Val Lys Ala Gly Asn Asp Gln  
Gly Ile Ala Thr Ala Ala Ala Ala Thr Asp Glu Leu Phe Lys Ser Tyr Asn Pro Asn Lys Ile Asp Gly  
Ile Phe Leu Thr Asn His Asp Gln Asn Arg Val Met Ser Glu Leu Ser Gly Asp Val Asn Lys Ala Lys  
Ser Ala Ala Ser Ile Leu Leu Thr Leu Pro Gly Asn Pro Tyr Ile Tyr Tyr Gly Glu Glu Ile Gly Met Thr  
Gly Glu Lys Pro Asp Glu Leu Ile Arg Glu Pro Phe Arg Trp Tyr Glu Gly Asn Gly Leu Gly Gln Thr  
Ser Trp Glu Thr Pro Val Tyr Asn Lys Gly Gly Asn Gly Val Ser Val Glu Val Gln Thr Lys Gln Lys  
Asp Ser Leu Leu Asn His Tyr Arg Glu Met Ile Arg Val Arg Gln Gln His Glu Glu Leu Val Lys Gly  
Thr Leu Gln Ser Ile Ser Val Asp Ser Lys Glu Val Val Ala Tyr Ser Arg Thr Tyr Lys Gly Asn Ser Ile  
Ser Val Tyr His Asn Ile Ser Asn Gln Pro Val Lys Val Ser Val Ala Ala Lys Gly Lys Leu Ile Phe Ala  
Ser Glu Lys Gly Ala Lys Lys Val Lys Asn Gln Leu Val Ile Pro Ala Asn Thr Thr Val Leu Ile Lys

SEQ ID NO: 185

atgaaactgatgaaagggaaaaatggacagcttttagctctaactgcccgtggtgctagcttatcaacaggcggttcacgccgaaactgtac  
ataaaggtaaagctccaacagcagataaaaacgggtgtctttatgagggtgatgaaactcttttacgatgcaaataaagatggacatggtgattta  
aaaggctctacacaaaagctggactatttaaatgacggaaattctatacaaaagaatgatcttcaagtaaacgggatttggatgatgccagtcac  
ccttctcctagctatcataaataatgatgaacggattattataacattgatccgcagtagcggaaatctgcaagatttgcgaagctgatgaaagaagc  
agacaaacgagacgtaaaagtcattatggacctgtgtgaatcatagcagcagcgaacacccttggtttcaagctgcgttaaaagataaaaaca  
gcaagtacagagattactatatttgggctgataaaaataccgacttgaatgaaaaggatcttggggacagcaagtagggcataaagctccaac  
ggagagtattttacggaacgttttgggaagggaatgcctgacttaattacgataaccctgaagtaagaaaagaatgattaacgtcggaaagttt  
ggctaaagcaaggcgttgatggctccgcttagatgctgcgttcatatttttaagggtcaaacgcctgaaggcgctaaagaaatattctgtggt  
ggaatgagtttagagatgcgatgaaaaagaaaaccctaactatatacagggtgaagtagtggaatcagcctgaagtggtagctccttactat  
caatcgcttgattccctatttaactttgatttagcagggaatgtcagttctgtaaaagcaggaaatgatcaaggaatcgccactgcagcagcgg  
caacggatgagctgttcaaatcatacaatccaaataaaattgacggcattttcttaaccaacatgacaaaaccgcgctatgagtgaactgatcg  
gcgatgtgaacaaagcaaaatcagctgcttctatcttacttacgcttctggaacccgtatatttattacgggtgaagaaattggcatgaccgggtga  
aaagcctgatgagttaatccgtgaaccgtccgctggtacgaaggaaacggacttggacaaccagctgggaaacacctgtatatacaaaagg

Figure 16ZZZ



cgccaacggcgtgtctgtagaagcacaaacaaacaaaaggattcttgttaaatcattaccgtgaaa:gattcgcgtgcgtcagcagcatgaag  
agttagtaaaaggaacgcttcaatctatttttagtagacagtaaaagaagttgttgcctatagccgtacgtataaagacaactcgattagcgtgtatcat  
aatatttcaaatcaaccggtaaaagtatctgtagcagcaaaaggtaaatatttttctagtgtgaaaaagggtgctaaaaaagtcaagaatcagcttg  
tgattccggctaatacaacgggttttaataaaataa

SEQ ID NO: 186

Met Lys Leu Met Lys Gly Lys Lys Trp Thr Ala Leu Ala Leu Thr Leu Pro Leu Ala Ala Ser Leu Ser  
Thr Gly Val His Ala Glu Thr Val His Lys Gly Lys Ala Pro Thr Ala Asp Lys Asn Gly Val Phe Tyr  
Glu Val Tyr Val Asn Ser Phe Tyr Asp Ala Asn Lys Asp Gly His Gly Asp Leu Lys Gly Leu Thr  
Gln Lys Leu Asp Tyr Leu Asn Asp Gly Asn Ser His Thr Lys Asn Asp Leu Gln Val Asn Gly Ile Trp  
Met Met Pro Val Asn Pro Ser Pro Ser Tyr His Lys Tyr Asp Val Thr Asp Tyr Tyr Asn Ile Asp Pro  
Gln Tyr Gly Asn Leu Gln Asp Phe Arg Lys Leu Met Lys Glu Ala Asp Lys Arg Asp Val Lys Val  
Ile Met Asp Leu Val Val Asn His Thr Ser Ser Glu His Pro Trp Phe Gln Ala Ala Leu Lys Asp Lys  
Asn Ser Lys Tyr Arg Asp Tyr Tyr Ile Trp Ala Asp Lys Asn Thr Asp Leu Asn Glu Lys Gly Ser Trp  
Gly Gln Gln Val Trp His Lys Ala Pro Asn Gly Glu Tyr Phe Tyr Gly Thr Phe Trp Glu Gly Met Pro  
Asp Leu Asn Tyr Asp Asn Pro Glu Val Arg Lys Glu Met Ile Asn Val Gly Lys Phe Trp Leu Lys  
Gln Gly Val Asp Gly Phe Arg Leu Asp Ala Ala Leu His Ile Phe Lys Gly Gln Thr Pro Glu Gly Ala  
Lys Lys Asn Ile Leu Trp Trp Asn Glu Phe Arg Asp Ala Met Lys Lys Glu Asn Pro Asn Val Tyr Leu  
Thr Gly Glu Val Trp Asp Gln Pro Glu Val Val Ala Pro Tyr Tyr Gln Ser Leu Asp Ser Leu Phe Asn  
Phe Asp Leu Ala Gly Lys Ile Val Ser Ser Val Lys Ala Gly Asn Asp Gln Gly Ile Ala Thr Ala Ala  
Ala Ala Thr Asp Glu Leu Phe Lys Ser Tyr Asn Pro Asn Lys Ile Asp Gly Ile Phe Leu Thr Asn His  
Asp Gln Asn Arg Val Met Ser Glu Leu Ile Gly Asp Val Asn Lys Ala Lys Ser Ala Ala Ser Ile Leu  
Leu Thr Leu Pro Gly Asn Pro Tyr Ile Tyr Tyr Gly Glu Glu Ile Gly Met Thr Gly Glu Lys Pro Asp  
Glu Leu Ile Arg Glu Pro Phe Arg Trp Tyr Glu Gly Asn Gly Leu Gly Gln Thr Ser Trp Glu Thr Pro  
Val Tyr Asn Lys Gly Gly Asn Gly Val Ser Val Glu Ala Gln Thr Lys Gln Lys Asp Ser Leu Leu Asn  
His Tyr Arg Glu Met Ile Arg Val Arg Gln Gln His Glu Glu Leu Val Lys Gly Thr Leu Gln Ser Ile  
Leu Val Asp Ser Lys Glu Val Val Ala Tyr Ser Arg Thr Tyr Lys Asp Asn Ser Ile Ser Val Tyr His  
Asn Ile Ser Asn Gln Pro Val Lys Val Ser Val Ala Ala Lys Gly Lys Leu Ile Phe Ala Ser Glu Lys  
Gly Ala Lys Lys Val Lys Asn Gln Leu Val Ile Pro Ala Asn Thr Thr Val Leu Ile Lys

SEQ ID NO: 187

ttgtatctcatccaggaggggcacatgcgtttccgccattattcaccgccttaccggcctggccgttccggttgagctctgcgtaccgcacag  
agctgcggcataggggagtttgcgacttgcgggttctgccgaattctgcaaaaaagccggatttgatctgtacagcttctccgggtcaatgac  
accggcacagaaagttctccatacagcgcgcttctgcttgccttgccctgcacccgctgtatcaggttctccgacctgacctgaagcagcgggttcc  
gaaaagcagattacagatctgaaaagccggttgaggacttgcctcgtttcagctatacggagctgcgccgtgccaaactggatatcctgcgtgc  
agtgtttgataaaaaaaggaaccatcatcggcagtgccgaactggaagcctggatttcagataacccctggatcatcgaatatgcgggttttat  
gaaccagaaacaccgcaacttgaagccggctggaacattgggaaaagctgcgaacccactcataacgaaatacaaaaaacctggcag  
ggtaaaacctggcaggctgaccatcaattcttgcattgctgcagatgcggctggaccagcagtttactgccggcgtacagagtgcaacgcc  
ctgggtgtctatcttaagggcgatatactataatgatgaacgaggttccgcagatgcctggcggaatccggaattctccgtgacgatcttcgg  
gccggaagtcccccgtgacgggtgaaaacccccagggaacaaactggggcttccccattataactgggaaaaccttgcaaatgacgggtacag  
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ggcgaatactccggctacctgggatggcccttgcgcagtaaccggtaagtgcagcagaactggcagaacggggcttttcaaggaccgctt  
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tcataaccgatcgtgtaagaagaactatggctgttcaagcccagatcacctgcgaggcagatatacgaacacaaacctgccgatgcc  
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cgtttccgtgacagcactgcatggcagacgcttaccgatggcgagaacactccctggaagagctgttcgccccaaaaagcggcgcaaatga  
aacctgtggcgagaacaggcgggtggaacttctgggtgagctgacgcgactacggatatgcttgcctgtgctgaagatctgggaagtattccc  
cacagtgtaccggaagtgtttcaaacctttcaattacagtctgcgggttaccgcgtgggcccgaatgggatgccccggccagcccttca  
cagactggaggagtatccgtcatgtcggtagcgaccccatcggttcatgattcctctaccctgcgcggatggtgggaaaccgaagcgccgca  
ccgggctttatggacgcatggcctccggaacaggatgcatacgcaggagcaggcccatgagttcgaaggcgctggggaccccgcca



Figure 16AAAA

ggcatcctgggtactccgtaaacctctgcgaagcccgttcgcgctctgtgttttccccatccaggataatttggccctgtctcagacttttatgcaat  
gacagcggagcaggaacgcataatattccgggcagtgtatccggatttaactggacataccggttgccctgcggcaatcgaggatttatctaaa  
aacagccaactataaccgcaatccagaccgcgttgaggaccgccggcgagggaaggcacaaggagcacagcaatga

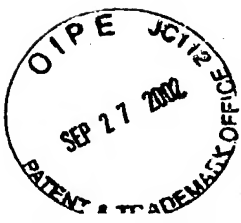
SEQ ID NO: 188

Met Tyr Leu Ile Gln Glu Gly His Met Arg Phe Pro Pro Ile Ile His Pro Leu Thr Gly Leu Ala Val Pro  
Val Gly Ala Leu Arg Thr Ala Gln Ser Cys Gly Ile Gly Glu Phe Ala Asp Leu Pro Val Leu Ala Glu  
Phe Cys Lys Lys Ala Gly Phe Asp Leu Val Gln Leu Leu Pro Val Asn Asp Thr Gly Thr Glu Ser Ser  
Pro Tyr Ser Ala Leu Ser Ala Phe Ala Leu His Pro Leu Tyr Ile Arg Leu Ser Asp Leu Pro Glu Ala  
Ala Gly Phe Glu Lys Gln Ile Thr Asp Leu Lys Ser Arg Phe Glu Asp Leu Pro Arg Phe Ser Tyr Thr  
Glu Leu Arg Arg Ala Lys Leu Asp Ile Leu Arg Ala Val Phe Asp Lys Asn Lys Ala Thr Ile Ile Gly  
Ser Ala Glu Leu Glu Ala Trp Ile Ser Asp Asn Pro Trp Ile Ile Glu Tyr Ala Val Phe Met Asn Gln  
Lys His Arg Asn Phe Glu Ala Gly Trp Lys His Trp Glu Lys Leu Arg Asn Pro Thr His Asn Glu Ile  
Gln Lys Thr Trp Gln Gly Lys Thr Trp Gln Ala Asp His Gln Phe Phe Ala Trp Leu Gln Met Arg Leu  
Asp Gln Gln Phe Thr Ala Ala Ala Thr Glu Cys Asn Ala Leu Gly Val Tyr Leu Lys Gly Asp Ile Pro  
Ile Met Met Asn Glu Asp Ser Ala Asp Ala Trp Ala Asn Pro Glu Phe Phe Arg Asp Asp Leu Arg  
Ala Gly Ser Pro Pro Asp Gly Glu Asn Pro Gln Gly Gln Asn Trp Gly Phe Pro Ile Tyr Asn Trp Glu  
Asn Leu Ala Asn Asp Gly Tyr Ser Trp Trp Lys Lys Arg Leu Lys His Ser Ala Arg Tyr Tyr His Ala  
Tyr Arg Ile Asp His Ile Leu Gly Phe Phe Arg Ile Trp Ala Ile Pro Tyr Gly Glu Tyr Ser Gly Tyr Leu  
Gly Trp Pro Leu Pro His Glu Pro Val Ser Ala Ala Glu Leu Ala Glu Arg Gly Phe Ser Lys Asp Arg  
Leu Arg Trp Leu Thr Glu Pro His Leu Pro Thr Arg Ala Ala Glu Glu Ala Asn Asn Trp Asp Tyr Leu  
Gly Thr His Gly Tyr Leu Asn Gln Ile Met Asn Arg Ile Gly Glu Glu Glu Leu Trp Leu Phe Lys Pro  
Glu Ile Thr Cys Glu Ala Asp Ile Arg Asn Thr Asn Leu Pro Asp Ala Leu Lys Glu Val Leu Val Arg  
Gln Trp Lys Asn Arg Leu Leu Gln Val Thr Gly Arg Asp Glu Lys Gly Arg Thr Ile Tyr Tyr Pro Leu  
Trp Arg Phe Arg Asp Ser Thr Ala Trp Gln Thr Leu Thr Asp Gly Glu Lys His Ser Leu Glu Glu Leu  
Phe Ala Gln Lys Ala Ala His Asn Glu Thr Leu Trp Arg Glu Gln Ala Val Glu Leu Leu Gly Glu Leu  
Thr Arg Ser Thr Asp Met Leu Ala Cys Ala Glu Asp Leu Gly Ser Ile Pro His Ser Val Pro Glu Val  
Leu Ser Asn Leu Ser Ile Tyr Ser Leu Arg Val Thr Arg Trp Ala Arg Gln Trp Asp Ala Pro Gly Gln  
Pro Phe His Arg Leu Glu Glu Tyr Pro Leu Met Ser Val Ala Thr Pro Ser Val His Asp Ser Ser Thr  
Leu Arg Gly Trp Trp Glu Thr Glu Gly Gly Asp Arg Ala Phe Met Asp Ala Trp Pro Pro Glu Gln  
Asp Ala Tyr Ala Gly Ala Gly Arg His Glu Phe Glu Gly Ala Trp Gly Pro Arg Gln Ala Ser Trp Val  
Leu Arg Lys Leu Cys Glu Ala Arg Ser Ala Leu Cys Val Phe Pro Ile Gln Asp Ile Leu Ala Leu Ser  
Ser Asp Phe Tyr Ala Met Thr Ala Asp Glu Glu Arg Ile Asn Ile Pro Gly Ser Val Ser Gly Phe Asn  
Trp Thr Tyr Arg Leu Pro Ala Ala Ile Glu Asp Leu Ser Lys Asn Ser Gln Leu Ile Thr Ala Ile Gln Thr  
Ala Leu Gln Asp Arg Arg Ala Arg Lys Ala Gln Gly Ala Gln Gln

SEQ ID NO: 189

atgcaaacgattgcaaaaaaggggatgaacgatgaaagggaaaaaatggacagcttttagcttaacactgccgctggctgctagcttatca  
acaggcgttcacgccgaaccgtacataaaggtaaatctccagctgcagataaaacgggtgcttttatgaggtgatgtaaacctcttttacgatg  
caaataaagatggacatggtgatttaaaaggctttacacaaaaactggactatttaaatgatggcaattctcatacaagaatgatcttcaagtaaa  
cgggatttgatgatgccgatcaaccttctcctagctatcataaatatgatgtaacggactattataacattgattctcagtacggaaatctgcaag  
atttcgcaagctaataaagaagcagataaacgagatgtaaaagtattatggacctcgttgtaatcatagcagcagtgaaacaccttggtttca  
agctgcgttaaaaataaaaacagcaagtagacagattactatatttggcgtgataaaaataccgatttgatgaaaaaggatcttggggacaac  
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aaggaaatcgctactgcagcagcggaacgatgaactgttcaaatcatacaatccaaataaaattgacggcattttcttaaccaatcatgacaaa  
atcgctgatgagtgaagtcaggagatgtcaataaagcaaaagtcagctgcctctatcttactacgttccctggaatccgtatatttattacggg  
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Figure 16BBBB



gaaacacctgtatacaataaaggcggcaacggcgtgtctgtagaagcacaaccaaacaaaaggactctttgttaaatcattaccgtgaaatgat  
tcgcgtgcgtcagcagcagcgaagagtagtaaaaggacgcttcaatctatttcagtagacagtaaaagaattgttgcctatagccgtacgtataa  
aggcaactccattagtgtgtatcataatattcaaatcaacctgtaaaagtatctgtagcagcgaaaggtaaatgtattttgctagtgtgaaaagggtg  
ctaaaaagggtcaaaaatcagcttgtgattccggcgaatacaacgggttttagtaaaaaaa

SEQ ID NO: 190

Met Gln Thr Ile Ala Lys Lys Gly Asp Glu Thr Met Lys Gly Lys Lys Trp Thr Ala Leu Ala Leu Thr  
Leu Pro Leu Ala Ala Ser Leu Ser Thr Gly Val His Ala Glu Thr Val His Lys Gly Lys Ser Pro Ala  
Ala Asp Lys Asn Gly Val Phe Tyr Glu Val Tyr Val Asn Ser Phe Tyr Asp Ala Asn Lys Asp Gly His  
Gly Asp Leu Lys Gly Leu Thr Gln Lys Leu Asp Tyr Leu Asn Asp Gly Asn Ser His Thr Lys Asn  
Asp Leu Gln Val Asn Gly Ile Trp Met Met Pro Ile Asn Pro Ser Pro Ser Tyr His Lys Tyr Asp Val  
Thr Asp Tyr Tyr Asn Ile Asp Ser Gln Tyr Gly Asn Leu Gln Asp Phe Arg Lys Leu Met Lys Glu Ala  
Asp Lys Arg Asp Val Lys Val Ile Met Asp Leu Val Val Asn His Thr Ser Ser Glu His Pro Trp Phe  
Gln Ala Ala Leu Lys Asp Lys Asn Ser Lys Tyr Arg Asp Tyr Tyr Ile Trp Ala Asp Lys Asn Thr Asp  
Leu Asn Glu Lys Gly Ser Trp Gly Gln Gln Val Trp His Lys Ala Pro Asn Gly Glu Tyr Phe Tyr Gly  
Thr Phe Trp Glu Gly Met Pro Asp Leu Asn Tyr Asp Asn Pro Glu Val Arg Lys Glu Met Ile Asn Val  
Gly Lys Phe Trp Leu Lys Gln Gly Val Asp Gly Phe Arg Leu Asp Ala Ala Leu His Ile Phe Lys Gly  
Gln Thr Pro Glu Gly Ala Lys Lys Asn Ile Val Trp Trp Asn Glu Phe Arg Asp Ala Met Lys Lys Glu  
Asn Pro Asn Val Tyr Leu Thr Gly Glu Val Trp Asp Gln Pro Glu Val Val Ala Pro Tyr Tyr Gln Ser  
Leu Asp Ser Leu Phe Asn Phe Asp Leu Ala Gly Lys Ile Val Ser Ser Val Lys Ala Gly Asn Asp Gln  
Gly Ile Ala Thr Ala Ala Ala Ala Thr Asp Glu Leu Phe Lys Ser Tyr Asn Pro Asn Lys Ile Asp Gly  
Ile Phe Leu Thr Asn His Asp Gln Asn Arg Val Met Ser Glu Leu Ser Gly Asp Val Asn Lys Ala Lys  
Ser Ala Ala Ser Ile Leu Leu Thr Leu Pro Gly Asn Pro Tyr Ile Tyr Tyr Gly Glu Glu Ile Gly Met Thr  
Gly Glu Lys Pro Asp Glu Leu Ile Arg Glu Pro Phe Arg Trp Tyr Glu Gly Asn Gly Leu Gly Gln Thr  
Ser Trp Glu Thr Pro Val Tyr Asn Lys Gly Gly Asn Gly Val Ser Val Glu Ala Gln Thr Lys Gln Lys  
Asp Ser Leu Leu Asn His Tyr Arg Glu Met Ile Arg Val Arg Gln Gln His Glu Glu Leu Val Lys Gly  
Thr Leu Gln Ser Ile Ser Val Asp Ser Lys Glu Val Val Ala Tyr Ser Arg Thr Tyr Lys Gly Asn Ser Ile  
Ser Val Tyr His Asn Ile Ser Asn Gln Pro Val Lys Val Ser Val Ala Ala Lys Gly Lys Leu Ile Phe Ala  
Ser Glu Lys Gly Ala Lys Lys Val Lys Asn Gln Leu Val Ile Pro Ala Asn Thr Thr Val Leu Val Lys

SEQ ID NO: 191

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caataaagatggacatgggtgacttaaaaggctttacacaaaagggtgactatttaaatgacggcaattctcatatacaaaaaatgatcttcaagtaaa  
cgggatttggatgagccagtcacaccttctcctagctatcataaatatgatgtaacggactattataacattgatccgcagtacgaaatctgcaa  
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gctaagaaagtcaaaaatcagcttgtgttccggcgaatacaacgggttttaataaataa

SEQ ID NO: 192

Figure 16CCCC



Met Gln Thr Ile Ala Lys Lys Gly Asp Glu Thr Met Lys Gly Lys Lys Trp Thr Ala Leu Ala Leu Thr  
Leu Pro Leu Ala Ala Ser Leu Ser Thr Gly Val His Ala Glu Thr Val His Lys Gly Lys Ser Pro Thr  
Ala Asp Lys Asn Gly Val Phe Tyr Glu Val Tyr Val Asn Ser Phe Tyr Asp Ala Asn Lys Asp Gly His  
Gly Asp Leu Lys Gly Leu Thr Gln Lys Leu Asp Tyr Leu Asn Asp Gly Asn Ser His Thr Lys Asn  
Asp Leu Gln Val Asn Gly Ile Trp Met Met Pro Val Asn Pro Ser Pro Ser Tyr His Lys Tyr Asp Val  
Thr Asp Tyr Tyr Asn Ile Asp Pro Gln Tyr Gly Asn Leu Gln Asp Phe Arg Lys Leu Met Lys Glu Ala  
Asp Lys Arg Asp Val Lys Val Ile Met Asp Leu Val Val Asn His Thr Ser Ser Glu His Pro Trp Phe  
Gln Ala Ala Leu Lys Asp Lys Asn Ser Lys Tyr Arg Asp Tyr Tyr Ile Trp Ala Asp Lys Asn Thr Asp  
Leu Asn Glu Lys Gly Ser Trp Gly Gln Gln Val Trp His Lys Ala Pro Asn Gly Glu Tyr Phe Tyr Gly  
Thr Phe Trp Glu Gly Met Pro Asp Leu Asn Tyr Asp Asn Pro Glu Val Arg Lys Glu Met Ile Asn Val  
Gly Lys Phe Trp Leu Lys Gln Gly Val Asp Gly Phe Arg Leu Asp Ala Ala Leu His Ile Phe Lys Gly  
Gln Thr Ala Glu Gly Ala Lys Lys Asn Ile Leu Trp Trp Asn Glu Phe Arg Asp Ala Met Lys Lys Glu  
Asn Pro Asn Val Tyr Leu Thr Gly Glu Val Trp Asp Gln Pro Glu Val Val Ala Pro Tyr Tyr Gln Ser  
Leu Asp Ser Leu Phe Asn Phe Asp Leu Ala Gly Lys Ile Val Ser Ser Val Lys Ala Gly Asn Asp Gln  
Gly Ile Ala Thr Ala Ala Ala Thr Asp Glu Leu Phe Lys Ser Tyr Asn Pro Asn Lys Ile Asp Gly  
Ile Phe Leu Thr Asn His Asp Gln Asn Arg Val Met Ser Glu Leu Ser Gly Asp Val Ser Lys Ala Lys  
Ser Ala Ala Ser Ile Leu Leu Thr Leu Pro Gly Asn Pro Tyr Ile Tyr Tyr Gly Glu Glu Ile Gly Met Thr  
Gly Glu Lys Pro Asp Glu Leu Ile Arg Glu Pro Phe Arg Trp Tyr Glu Gly Asn Gly Leu Gly Gln Thr  
Ser Trp Glu Thr Pro Val Tyr Asn Lys Gly Gly Asn Gly Val Ser Val Glu Ala Gln Thr Lys Gln Lys  
Asp Ser Leu Leu Asn His Tyr Arg Glu Met Ile Arg Val Arg Gln Gln His Glu Glu Leu Val Lys Gly  
Thr Leu Gln Ser Ile Ser Val Asp Ser Lys Glu Val Val Ala Tyr Ser Arg Thr Tyr Lys Gly Asn Ser Ile  
Ser Val Tyr His Asn Ile Ser Asn Gln Pro Val Lys Val Ser Val Ala Ala Lys Gly Lys Leu Ile Phe Ala  
Ser Glu Lys Gly Ala Lys Lys Val Lys Asn Gln Leu Val Val Pro Ala Asn Thr Thr Val Leu Met Lys

SEQ ID NO: 193

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gtcgggtgattatgccacctacagatcacgtttgacagccagacgaaggccatcaccgtgacttcgcagtaa

SEQ ID NO: 194

Met Lys Phe Lys Lys Ser Leu Ser Ala Gly Leu Leu Leu Phe Gly Gly Leu Ser Gly Val Thr Pro Ser  
Val Ala Ala Glu Val Pro Arg Thr Ala Phe Val His Leu Phe Glu Trp Ser Trp Pro Asp Ile Ala Thr

Figure 16DDDD



Glu Cys Glu Thr Phe Leu Gly Pro Lys Gly Phe Ser Ala Val Gln Val Ser Pro Pro Gln Lys Ser Val  
Ser Asn Ala Ala Trp Trp Ala Arg Tyr Gln Pro Val Ser Tyr Ser Phe Glu Gly Arg Ser Gly Thr Arg  
Ala Gln Phe Ala Asp Met Val Gln Arg Cys Lys Ala Val Gly Val Asp Ile Tyr Leu Asp Ala Val Ile  
Asn His Met Ala Ala Gln Asp Arg Tyr Phe Pro Glu Val Pro Tyr Ser Ser Asn Asp Phe His Ser Cys  
Thr Gly Asp Ile Asp Tyr Ser Asn Arg Trp Ser Ile Gln Asn Cys Asp Leu Val Gly Leu Asn Asp Leu  
Lys Thr Glu Ser Glu Tyr Val Arg Gln Lys Ile Ala Asp Tyr Met Asn Asp Ala Leu Ser Leu Gly Val  
Ala Gly Phe Arg Ile Asp Ala Ala Lys His Ile Pro Ala Gly Asp Ile Ala Ala Ile Lys Ser Lys Leu Asn  
Gly Ser Pro Tyr Ile Tyr Gln Glu Val Ile Gly Ala Ala Gly Glu Pro Val Gln Thr Ser Glu Tyr Thr Tyr  
Ile Gly Asp Val Thr Glu Phe Asn Phe Ala Arg Thr Ile Gly Pro Lys Phe Lys Gln Gly Asn Ile Lys  
Asp Leu Gln Gly Ile Gly Ser Trp Ser Gly Trp Leu Ser Ser Asp Asp Ala Val Thr Phe Val Thr Asn  
His Asp Glu Glu Arg His Asn Pro Gly Gln Val Leu Ser His Gln Asp Phe Gly Asn Leu Tyr Phe Leu  
Gly Asn Val Phe Thr Leu Ala Tyr Pro Tyr Gly Tyr Pro Lys Val Met Ser Gly Tyr Tyr Phe Ser Asn  
Phe Asp Ala Gly Pro Pro Ser Thr Gly Val His Ser Gly Asn Ala Cys Gly Phe Asp Gly Gly Asp Trp  
Val Cys Glu His Lys Trp Arg Gly Val Ala Asn Met Val Ala Phe Arg Asn His Thr Ala Ala Gln Trp  
Gln Val Thr Asp Trp Trp Asp Asp Gly Tyr Asn Gln Val Ala Phe Gly Arg Gly Gly Leu Gly Phe  
Val Val Ile Asn Arg Asp Asp Asn Lys Gly Ile Asn Gln Ser Phe Gln Thr Gly Met Pro Ala Gly Glu  
Tyr Cys Asp Ile Ile Ala Gly Asp Phe Asp Thr Gln Ser Gly His Cys Ser Ala Thr Thr Ile Thr Val  
Asp Ser Gln Gly Tyr Ala His Phe Thr Val Gly Ser His Gln Ala Ala Ala Ile His Ile Gly Ala Lys Leu  
Gly Ser Val Cys Gln Asp Cys Gly Gly Thr Ala Ala Glu Thr Lys Val Cys Phe Asp Asn Ala Gln  
Asn Phe Ser Gln Pro Tyr Leu His Tyr Trp Asn Val Asn Ala Asp Gln Ala Val Ala Asn Ala Thr Trp  
Pro Gly Val Ala Met Thr Ala Glu Asn Gly Gly Tyr Cys Tyr Asp Phe Gly Val Gly Leu Asn Ser Leu  
Gln Val Ile Phe Ser Asp Asn Gly Ala Ser Gln Thr Ala Asp Leu Thr Ala Ser Ser Pro Thr Leu Cys  
Tyr Gln Asn Gly Thr Trp Arg Asp Ser Asp Phe Cys Gln Ser Ser Asn Val Gly Asn Glu Ser Trp Tyr  
Phe Arg Gly Thr Ser Asn Gly Trp Gly Val Ser Ala Leu Thr Tyr Glu Ala Ala Thr Gly Leu Tyr Thr  
Thr Val Gln Ser Phe Asn Gly Glu Glu Ser Pro Ala Arg Phe Lys Ile Asp Asp Gly Asn Trp Ser Glu  
Ser Tyr Pro Ser Ala Asp Tyr Gln Val Gly Asp Tyr Ala Thr Tyr Thr Ile Thr Phe Asp Ser Gln Thr  
Lys Ala Ile Thr Val Thr Ser Gln

SEQ ID NO: 195

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Figure 16EEEE



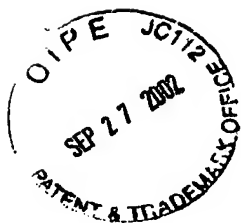
Applicant(s): Walter Callen et al.  
ENZYMES HAVING ALPHA AMYLASE ACTIVITY AND  
METHODS OF USE THEREOF

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SEQ ID NO: 196

Met Leu Thr Asp Arg Phe Phe Asp Gly Asp Thr Ser Asn Asn Asp Pro Tyr Asn Gln Asn Tyr Asp  
Ala Lys Asn Asp Arg Gly Thr Tyr Gln Gly Gly Asp Phe Lys Gly Ile Thr Gln Lys Leu Asp Tyr Leu  
Asp Lys Leu Gly Val Asn Thr Ile Trp Ile Ser Pro Ile Val Glu Asn Ile Lys His Asp Val Arg Tyr Asp  
Asn Ser Glu Gly His Ser Tyr Tyr Ala Tyr His Gly Tyr Trp Ala Ser Asn Phe Gly Ala Leu Asn Pro  
His Phe Gly Thr Met Glu Asp Phe His Thr Leu Ile Asp Ala Ala His Glu Lys Gly Ile Lys Ile Met  
Val Asp Val Val Leu Asn His Thr Gly Tyr Gly Leu Lys Asp Ile Asn Gly Glu Val Ser Asn Pro Pro  
Ala Gly Tyr Pro Thr Asp Ala Glu Arg Ser Thr Tyr Ser Ser Leu Leu Arg Gln Gly Ser Asn Val Gly  
Ser Asp Glu Val Val Gly Glu Leu Ala Gly Leu Pro Asp Leu Lys Thr Glu Asp Pro Ala Val Arg Gln  
Thr Ile Ile Asp Trp Gln Thr Asp Trp Ile Thr Lys Ala Thr Thr Ala Lys Gly Asn Thr Ile Asp Tyr Phe  
Arg Val Asp Thr Val Lys His Val Glu Asp Ala Thr Trp Met Ala Phe Lys Asn Asp Leu Thr Glu  
Lys Met Pro Thr His Lys Met Ile Gly Glu Ala Trp Gly Ala Ser Ala Asn Asn Gln Leu Gly Tyr Leu  
Glu Thr Gly Met Met Asp Ser Leu Leu Asp Phe Asp Phe Lys Gly Ile Ala His Asp Phe Val Asn Gly  
Lys Leu Lys Ala Ala Asn Asp Ala Leu Thr Ala Arg Asn Gly Lys Ile Asp Asn Thr Ala Thr Leu Gly  
Ser Phe Leu Gly Ser His Asp Glu Asp Gly Phe Leu Phe Lys Glu Gly Asn Asp Lys Gly Lys Leu  
Lys Val Ala Ala Ser Leu Gln Ala Thr Ser Lys Gly Gln Pro Val Ile Tyr Tyr Gly Glu Glu Leu Gly  
Gln Ser Gly Ala Asn Asn Tyr Pro Gln Tyr Asp Asn Arg Tyr Asp Leu Ala Trp Asp Lys Val Glu  
Asn Asn Asp Val Leu Glu His Tyr Thr Lys Val Leu Asn Phe Arg Ser Ala His Ser Glu Val Phe Ala  
Lys Gly Glu Arg Ala Thr Ile Gly Gly Ser Asp Ala Asp Lys Phe Leu Leu Phe Ala Arg Lys Asn Gly  
Asn Glu Ala Ala Tyr Val Gly Leu Asn Val Ala Asp Thr Ala Lys Asp Val Thr Leu Thr Val Ser Ala  
Gly Ala Val Val Thr Asp His Tyr Ala Asp Lys Thr Tyr Thr Ala Ser Glu Ala Gly Glu Ile Thr Leu  
Thr Ile Pro Ala Lys Ala Asp Gly Gly Thr Val Leu Leu Thr Val Glu Gly Gly Glu Thr Ala Ala  
Lys Ala Ala Ser Glu Gly Asp Gly Thr Val Glu Pro Val Pro Ala Asn His Ile Arg Ile His Tyr Asn  
Arg Thr Asp Asn Asn Tyr Glu Asn Tyr Gly Ala Trp Leu Trp Asn Asp Val Ala Ser Pro Ser Ala Asn  
Trp Pro Thr Gly Ala Thr Met Phe Glu Lys Thr Asp Ser Tyr Gly Ala Tyr Ile Asp Val Pro Leu Lys  
Glu Gly Ala Lys Asn Ile Gly Phe Leu Val Met Asp Val Thr Lys Gly Asp Gln Gly Lys Asp Gly Gly  
Asp Lys Gly Phe Thr Ile Ser Ser Pro Glu Met Asn Glu Ile Trp Ile Lys Gln Gly Ser Asp Lys Val  
Tyr Thr Tyr Glu Pro Val Asp Leu Pro Ala Asn Thr Val Arg Val His Tyr Val Arg Asp Asn Ala Asp  
Tyr Glu Asn Phe Gly Ile Trp Asn Trp Gly Asp Val Thr Ala Pro Ser Glu Asn Trp Pro Thr Gly Ala  
Ala Lys Phe Asp Gly Thr Asp Arg Tyr Gly Ala Tyr Val Asp Ile Thr Leu Lys Glu Gly Ala Lys Asn  
Ile Gly Met Ile Ala Leu Asn Thr Ala Asn Gly Glu Lys Asp Gly Gly Asp Lys Ser Phe Asn Leu Leu  
Asp Lys Tyr Asn Arg Ile Trp Ile Lys Gln Gly Asp Asp Asn Val Tyr Val Ser Pro Tyr Trp Glu Gln  
Ala Thr Gly Ile Thr Asn Ala Glu Val Ile Ser Glu Asp Thr Ile Leu Leu Gly Phe Thr Met Thr Asp  
Gly Leu Thr Pro Glu Ser Leu Lys Gly Gly Leu Val Ile Lys Asp Ser Thr Gly Ala Glu Val Ala Ile  
Glu Ser Ala Glu Ile Thr Ser Ala Thr Ser Val Lys Val Lys Ala Thr Phe Asp Leu Glu Lys Leu Pro  
Leu Ser Ile Thr Tyr Ala Gly Arg Thr Val Ser Ala Ser Thr Gly Trp Arg Met Leu Asp Glu Met Tyr  
Ala Tyr Asp Gly Asn Asp Leu Gly Ala Thr Tyr Lys Asp Gly Ala Ala Thr Leu Lys Leu Trp Ala Pro  
Lys Ala Ser Lys Val Thr Ala Asn Phe Phe Asp Lys Asn Asn Ala Ala Glu Lys Ile Gly Ser Val Glu  
Leu Thr Lys Gly Glu Lys Gly Val Trp Ser Ala Met Val Ala Pro Gly Asp Leu Asn Val Thr Asp Leu  
Glu Gly Tyr Phe Tyr Gln Tyr Asp Val Thr Asn Asp Gly Ile Thr Arg Gln Val Leu Asp Pro Tyr Ala

Figure 16FFFF



Lys Ser Met Ala Ala Phe Thr Val Asn Thr Glu Gly Asn Ala Gly Pro Asp Gly Asp Thr Val Gly Lys  
Ala Ala Ile Gln Lys Ala Ser Arg Glu Tyr Phe

SEQ ID NO: 197

atgaaaccgtcaaaattcgtttttctctctgctgccatcgcttgcagcctctccagtagcccaatgctgacgccattttgcatgcatttaactggaag  
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tggtgggcacgttatcaaccgaagatctgcgcgtgatcgattccccacttggcaacaaagtgacttaaatccatgattgatgctctgaaggc  
ggcggcggtgatgtgatgccgatgtggtgcttaaccatagggcaatgaacatggaagcgtgaagacttaaatccctggcagtgaaagtc  
lgcaacaatacgcagctaacaccagttattatgcggaccaaacgcttttggcaatttaacgaaaacctattctctggctttgacttccaccaga  
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acaactgggtggtgtcacagcaacgtttgtattgaatgcgctaaaagggttaggtgtgaaaggctccgcattgatcggtttaaaccatgatgcc  
aatatcaaatcgaccagattttcactgcagagattaccgcccgaatgcacgtgttgggtgaagtgtaccagtggtggcaaggcgactccag  
ctatgagaacttcttagcgccttatctcaacgccaccaaccattcggttacgatttccactgttgcctctattcgaacgccttctctacagcg  
tgcatgaacatgcttcatgatccacaagcctatggcaagggttgaaacgcacgttcaattacccttaccatcacgcacacatcccaacga  
acgacggtttccgttatcaaatcatggatccgaaagatgaagactggcttacgcttatactcgttaaagatggcgccacacctctgattaca  
gcgacaacttacctgataacgaagatcgataatcgccgttgggaagggtgttggaaaccgtgacctgatgaagaacatgttgcgttccataac  
caatgaaggcgcaagagatgacgatgctgtacagcgaccaatgtctactgatgtttaaagcgcggttaaacaagggtgtgctggcattaataat  
gcggtgaagagcggttctacacgttgacacctatcagcatgagtcaactggtatcagccttacacagatacactcactggcgtgactgaaacc  
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SEQ ID NO: 198

Met Lys Pro Ser Lys Phe Val Phe Leu Ser Ala Ala Ile Ala Cys Ser Leu Ser Ser Thr Ala Asn Ala  
Asp Ala Ile Leu His Ala Phe Asn Trp Lys Tyr Ser Asp Val Thr Gln Asn Ala Ser Gln Ile Ala Ala  
Ala Gly Tyr Lys Lys Val Leu Ile Ser Pro Ala Leu Lys Ser Ser Gly Asn Glu Trp Trp Ala Arg Tyr  
Gln Pro Gln Asp Leu Arg Val Ile Asp Ser Pro Leu Gly Asn Lys Ser Asp Leu Lys Ser Met Ile Asp  
Ala Leu Lys Ala Val Gly Val Asp Val Tyr Ala Asp Val Val Leu Asn His Met Ala Asn Glu Thr Trp  
Lys Arg Glu Asp Leu Asn Tyr Pro Gly Ser Glu Val Leu Gln Gln Tyr Ala Ala Asn Thr Ser Tyr Tyr  
Ala Asp Gln Thr Leu Phe Gly Asn Leu Thr Glu Asn Leu Phe Ser Gly Phe Asp Phe His Pro Glu  
Gly Cys Ile Ser Asp Trp Asn Asp Ala Gly Asn Val Gln Tyr Trp Arg Leu Cys Gly Gly Ala Gly Asp  
Arg Gly Leu Pro Asp Leu Asp Pro Asn Asn Trp Val Val Ser Gln Gln Arg Leu Tyr Leu Asn Ala  
Leu Lys Gly Leu Gly Val Lys Gly Phe Arg Ile Asp Ala Val Lys His Met Ser Gln Tyr Gln Ile Asp  
Gln Ile Phe Thr Ala Glu Ile Thr Ala Gly Met His Val Phe Gly Glu Val Ile Thr Ser Gly Gly Lys Gly  
Asp Ser Ser Tyr Glu Asn Phe Leu Ala Pro Tyr Leu Asn Ala Thr Asn His Ser Ala Tyr Asp Phe Pro  
Leu Phe Ala Ser Ile Arg Asn Ala Phe Ser Tyr Ser Gly Gly Met Asn Met Leu His Asp Pro Gln Ala  
Tyr Gly Gln Gly Leu Glu Asn Ala Arg Ser Ile Thr Phe Thr Ile Thr His Asp Ile Pro Thr Asn Asp  
Gly Phe Arg Tyr Gln Ile Met Asp Pro Lys Asp Glu Glu Leu Ala Tyr Ala Tyr Ile Leu Gly Lys Asp  
Gly Gly Thr Pro Leu Ile Tyr Ser Asp Asn Leu Pro Asp Asn Glu Asp Arg Asp Asn Arg Arg Trp  
Glu Gly Val Trp Asn Arg Asp Leu Met Lys Asn Met Leu Arg Phe His Asn Gln Met Gln Gly Gln  
Glu Met Thr Met Leu Tyr Ser Asp Gln Cys Leu Leu Met Phe Lys Arg Gly Lys Gln Gly Val Val  
Gly Ile Asn Lys Cys Gly Glu Glu Arg Ser His Thr Val Asp Thr Tyr Gln His Glu Phe Asn Trp Tyr  
Gln Pro Tyr Thr Asp Thr Leu Thr Gly Val Thr Glu Thr Val Ser Ser Arg Tyr His Thr Phe Arg Ile  
Pro Ala Arg Ser Ala Arg Met Tyr Met Leu

SEQ ID NO: 199

gtgagtttgacaaaaaggctcagtagcgaacaaatcggcaccgaaggctcagtagcatctctgcaatcaatgccgcgcacacaacaatatcca  
aatttacggcgatgttgtgttaaccaccgaggtggtgctgatgggaagtcgtgggtcgataccaagcgcgttgattgggacaaccgcaatattg  
aactggcgacaaatggattgaagcttgggttgagtttaatttcttggccgcaacgacaaatactcgaacttccattggacttggatcatttgac  
gggttgactgggatgacggcgcaagaaaaagcgatcttaaatcaaaaggcgaaggaaaagcatgggattgggaagtcagctctgaaaa  
aggcaattacgactacctaa

Figure 16GGGG



## SEQ ID NO: 200

Val Ser Leu Thr Lys Lys Ala Gln Tyr Glu Pro Asn Thr Ala Pro Arg Leu Ser Thr Ser Leu Gln Ser  
Met Pro Arg Thr Thr Thr Ile Ser Lys Phe Thr Ala Met Leu Cys Leu Thr Thr Glu Val Val Leu Met  
Gly Ser Arg Gly Ser Ile Pro Ser Ala Leu Ile Gly Thr Thr Ala Ile Leu Asn Trp Ala Thr Asn Gly Leu  
Lys Leu Gly Leu Ser Leu Ile Phe Leu Ala Ala Thr Thr Asn Thr Arg Thr Ser Ile Gly Leu Gly Ile  
Thr Leu Thr Val Leu Thr Gly Met Thr Pro Ala Lys Lys Lys Arg Ser Leu Asn Ser Lys Ala Lys Glu  
Lys His Gly Ile Gly Lys Ser Ala Leu Lys Lys Ala Ile Thr Thr Thr

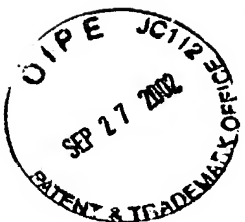
## SEQ ID NO: 201

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ttgaatctattccgggtggagggaacaagaccattggggcgacaggcttgatgtacaggctactttgccagtactattcaagatagacctcgct  
ttggcaggttagaacaagcccgtgagctggtggaaaaggcacacgcgaaaggcttgatgtctctttgatggagtatttgccaccataaaggc  
aatgtggtgccatcaccacaaggttagactgcctgtcgggtgaaaataacccggtcagctaccagagagcctggcggtttacgaagaagtcgcc  
agttactgggtgaaagagttaaagattgatgctggcgtcgtggaatcaagtgccgaccgatgcagaaagcgatccgtcagagc  
gttgatgaagcgtcacagtccttaacttatgtaataacaaaggggaaaccgtccatcctttgggttacatggtggctgaaatttgaataacgaa  
cgttacatcacagaaaccggttacggcaaaagaaggcgatccggcggttgctcggcttttgatttccgatgcgttccgagtggtcgaaacctt  
gcggttaacgaaagtgtgtcagccgaaaaggcgcggaatggttgatgacggcatgtcactgcacagtcagtatccggatcatgccaaacct  
aatatggtgggcaaccatgatgtggtgcgcttggggatctgctgcaacgtggcggtattgcgtcaccagaacaaccgcaatactggcagcg  
tcataaagcggcgatgtcttcttagcagcgataaccggccaattaccttgattacggtgaagaaattggcgatcaggttgacggcttgctaaa  
aaaatcaaagaagattgtgccgttattggttggtgatgaccacgtggcgcgaccagtgcgaaagattgatggcggtacggcgctcactgaatg  
cacagcagtcgaactcaaaagtatatgtcttcattgatgacattacgtcagcaacatcctgcgttatcacaaaggggaacgtactaatgtgatggc  
gacagagacagtatacgtagaccataaacaggcgacacaatgaagccctgttgatcatggtgagtacgactgataacgcggagtcagtcacctt  
gaagggcaaagcgattggttcacaaggtgtgctgattgatttgaacgaacgagcggtttatgcccaataatggggagtagtccattccattaac  
gggcttggcgacgattcctcaagattgacactccgacagcggcggtgtgatggcgcaatctgctgcctcggtatcgtagtagtggaagg  
gatcatggcccaatgtgatacccaaccgtgaaggcaccgggtccggtagcagaacacctgtacgtggttggcgatttggcgatgctggttga  
agcaaaagccgcagcgcgctatcaatacaaaggcaagcacaatggcagcaactgtatcaagtgtgtgatgaaaagcggcgccctac  
aagatgaatacggcacgaaagattggagcccacagttactgcagacgggatggcattgaagccgggtaccgcaaagtcgctcatagcgggt  
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atggtgtctaagtgtcagtaa

## SEQ ID NO: 202

Met Thr Ala Lys Ala Asp Asp Leu Arg Ile Tyr Gln Ile Met Val Glu Ser Phe Val Asp Gly Asp Lys  
Gln Val Gly His Gly Thr Gly Tyr Gly Thr Ser His His Lys Gly Asp Leu Gln Gly Ile Ile Asp Ser  
Leu Asp Tyr Ile Gln Ser Leu Gly Val Asn Ala Ile Trp Leu Thr Pro Ile Phe Glu Ser Ile Pro Val Glu  
Gly Gln Asp His Trp Ala Asp Arg Leu Asp Ala Thr Gly Tyr Phe Ala Ser Asp Tyr Phe Lys Ile Asp  
Pro Arg Phe Gly Thr Leu Glu Gln Ala Arg Glu Leu Val Glu Lys Ala His Ala Lys Gly Leu Tyr Val  
Phe Phe Asp Gly Val Phe Gly His His Lys Gly Asn Val Val Pro Ser Pro Gln Gly Arg Leu Pro Val  
Gly Glu Asn Asn Pro Val Ser Tyr Pro Glu Ser Leu Ala Phe Tyr Glu Glu Val Ala Ser Tyr Trp Val  
Lys Glu Leu Lys Ile Asp Gly Trp Arg Leu Asp Gln Ala Tyr Gln Val Pro Thr Asp Ala Trp Lys Ala  
Ile Arg Gln Ser Val Asp Glu Ala Ser Gln Ser Val Thr Tyr Val Asn Asn Lys Gly Glu Thr Val His  
Pro Leu Gly Tyr Met Val Ala Glu Ile Trp Asn Asn Glu Arg Tyr Ile Thr Glu Thr Gly Tyr Gly Lys  
Glu Gly Asp Pro Ala Leu Cys Ser Ala Phe Asp Phe Pro Met Arg Phe Arg Val Val Glu Thr Phe Ala  
Val Asn Glu Ser Gly Val Ser Arg Lys Gly Gly Glu Trp Leu Asn Asp Gly Met Ser Leu His Ser Gln  
Tyr Pro Asp His Ala Lys Pro Asn Leu Met Leu Gly Asn His Asp Val Val Arg Phe Gly Asp Leu  
Leu Gln Arg Gly Gly Ile Ala Ser Pro Glu Gln Pro Gln Tyr Trp Gln Arg His Lys Ala Ala Met Ser  
Phe Leu Ala Ala Tyr Thr Gly Pro Ile Thr Leu Tyr Tyr Gly Glu Glu Ile Gly Asp Gln Val Asp Gly  
Phe Ala Lys Lys Ile Lys Glu Asp Cys Ala Val Ile Gly Leu Cys Asp Asp His Val Ala Arg Thr Ser  
Ala Lys Ile Asp Gly Val Thr Ala Ser Leu Asn Ala Gln Gln Ser Glu Leu Lys Val Tyr Val Ser Ser  
Leu Met Thr Leu Arg Gln Gln His Pro Ala Leu Ser Gln Gly Glu Arg Thr Asn Val Met Ala Thr Glu

Figure 16HHHH



Thr Val Tyr Val Asn His Lys Gln Ala Asp Asn Glu Ala Leu Leu Tyr Met Val Ser Thr Thr Asp Asn  
Ala Glu Ser Val Thr Leu Lys Gly Lys Ala Ile Gly Ser Gln Gly Val Leu Ile Asp Leu Leu Thr Asn  
Glu Arg Phe Met Pro Asn Asn Gly Glu Tyr Ala Ile Pro Leu Thr Gly Phe Gly Ala Arg Phe Leu Lys  
Ile Asp Thr Pro Thr Ala Ala Gly Val Met Ala Gln Ser Ala Ala Ser Val Ser Leu Val Gly Glu Gly Ile  
Met Ala Gln Cys Asp Thr Pro Thr Val Glu Gly Thr Gly Pro Val Ala Glu Thr Leu Tyr Val Val Gly  
Asp Phe Ala Asp Ala Gly Trp Lys Gln Lys Pro Gln Arg Ala Tyr Gln Tyr Lys Gly Lys His Asn Gly  
Ser Asn Leu Tyr Gln Val Val Val Asp Glu Lys Ala Gly Ala Tyr Lys Met Gln Tyr Ala Thr Lys Asp  
Trp Ser Pro Gln Phe Thr Ala Asp Gly Met Ala Leu Lys Pro Gly Thr Ala Lys Ser Leu Ile Ala Gly  
Gly Tyr Gly Lys Asp Thr Ala Val Thr Leu Pro Glu Ser Gly Lys Tyr Val Trp Ser Leu Thr Phe Ser  
Asp Leu Gly Glu Pro Glu Gln Ile

SEQ ID NO: 203

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ccagtggagtgacaatgacatcgccaacgagtgcaaaagggtgctcgggtcccaagggtatgaagcagtgacatcacgccgctgtgaa  
cacctgcaaggctcctcctggtgggtggtctatcagcccgctcagctacaagaacttcacttctctggcggtaacgaggccgaactcaaaagca  
tgatgccccgttgaaggccgcccgggtcaagatttacgccgatgctggtattcaaccagctggctggtgatcaggcgctcggtacaggtggtgta  
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tgtgcaaaacgggtgcctgtctggggctgccggtatctggataccggctctgcttatgtgcaggatcagctggctacatatgaagacctgagt  
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ctactccgaggtgattggtgccacgggtgaaccaatccagccggcgcaatataccggcattggtgctgacgaatttaataacggcaccga  
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gcctggccctatggcgccatccccaggtgatgtccggctatgattcggcaccaataccgatattggtggcgagcgctacccctgttcttcc  
ggctctagctggaactgcgaacacggctggagcaacatcgccaacatggtctcgttccacaatgccgccccaggcagctccatgaccaactg  
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tcaccgtcaccgatggcagcgtggcttataacagcaactttgccagcctgaacttccgtggcactcccaacagttggggcgccgagccatga  
cgctggtggcagacaacacctgggaggcaacggtaacttcgatggtcaggccaatcagcgcttcaagttcgatacaagggtgactggagc  
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ccccgaacagctggggcaccaccgccatgaagctggtggccaataacagctggcaggccgaggtgaccttaccggcaaggcgccgatgcca  
ctggtgccaacgcttcaagttcgacgtcaagggtgactggagccagaactacggtgacagcaacatggacgggactgcccgaacggactgg  
tggcgatatcaccagtgccgtggtgggcacatctggtgacctttaatgacagcacactgaaatacacctgaccgccaataa

SEQ ID NO: 204

Met Lys Met Lys Ser Arg Ala Trp Leu Leu Gly Ser Ala Val Ala Met Ala Leu Ala Ser Ser Ala Ala  
Asn Ala Gly Val Met Val His Leu Phe Gln Trp Lys Tyr Asn Asp Ile Ala Asn Glu Cys Glu Lys Val  
Leu Gly Pro Lys Gly Trp Glu Ala Val Gln Ile Thr Pro Pro Ala Glu His Leu Gln Gly Ser Ser Trp  
Trp Val Val Tyr Gln Pro Val Ser Tyr Lys Asn Phe Thr Ser Leu Gly Gly Asn Glu Ala Glu Leu Lys  
Ser Met Ile Ala Arg Cys Lys Ala Ala Gly Val Lys Ile Tyr Ala Asp Ala Val Phe Asn Gln Leu Ala  
Gly Gly Ser Gly Val Thr Gly Gly Ser Ser Tyr Asn Ala Gly Ser Phe Ser Tyr Pro Gln Phe Gly  
Tyr Asn Asp Phe His His Ala Gly Ser Leu Thr Asn Tyr Ala Asp Arg Asn Asn Val Gln Asn Gly  
Ala Leu Leu Gly Leu Pro Asp Leu Asp Thr Gly Ser Ala Tyr Val Gln Asp Gln Leu Ala Thr Tyr Met

Figure 16III



Lys Thr Leu Ser Gly Trp Gly Val Ala Gly Phe Arg Leu Asp Ala Ala Lys His Met Ser Val Ala Asp  
Leu Ser Ala Ile Val Ser Lys Ala Gly Asn Pro Phe Val Tyr Ser Glu Val Ile Gly Ala Thr Gly Glu Pro  
Ile Gln Pro Gly Glu Tyr Thr Gly Ile Gly Ala Val Thr Glu Phe Lys Tyr Gly Thr Asp Leu Ala Ser  
Asn Phe Lys Gly Gln Ile Lys Asn Leu Lys Ser Met Gly Glu Ser Trp Gly Leu Leu Ala Ser Asn Lys  
Ala Glu Val Phe Val Val Asn His Asp Arg Glu Arg Gly His Gly Gly Gly Met Leu Thr Tyr Lys  
Asp Gly Ala Leu Tyr Asn Leu Ala Asn Ile Phe Met Leu Ala Trp Pro Tyr Gly Ala Tyr Pro Gln Val  
Met Ser Gly Tyr Asp Phe Gly Thr Asn Thr Asp Ile Gly Gly Pro Ser Ala Thr Pro Cys Ser Ser Gly  
Ser Ser Trp Asn Cys Glu His Arg Trp Ser Asn Ile Ala Asn Met Val Ser Phe His Asn Ala Ala Gln  
Gly Thr Ser Met Thr Asn Trp Trp Asp Asn Gly Asn Asn Gln Ile Ala Phe Gly Arg Gly Ala Lys Ala  
Phe Val Val Ile Asn Asn Glu Ser Ser Thr Leu Ser Lys Ser Leu Gln Thr Gly Leu Pro Ala Gly Glu  
Tyr Cys Asn Ile Leu Ala Gly Asp Ala Leu Cys Ser Gly Ser Thr Ile Lys Val Asp Ala Ser Gly Met  
Ala Thr Phe Asn Val Ala Gly Met Lys Ala Ala Ala Ile His Ile Asn Ala Lys Pro Asp Ser Thr Ser  
Ser Gly Ser Ser Gly Ser Ser Ser Gly Ser Ser Ser Ala Thr Ser Asn Lys Phe Ala Ser Met Asn Leu  
Arg Gly Thr Asn Asn Gly Trp Ala Ser Thr Ala Met Thr Val Asp Ala Asn Arg Val Trp Ser Ala Asp  
Val Thr Phe Thr Gly Ala Ala Asp Ala Asn Gly Ala Gln Arg Phe Lys Phe Asp Val Tyr Gly Asn Trp  
Thr Glu Ser Tyr Gly Asp Thr Gln Ala Asp Gly Ile Ala Asp Lys Gly Ser Ala Lys Asp Ile Tyr Phe  
Asn Gly Val Gly Lys Tyr Arg Val Ser Leu Lys Glu Ser Asp Met Ser Tyr Thr Leu Thr Gln Leu Ser  
Ser Asn Gln Ala Pro Val Ala Ala Ile Thr Pro Lys Thr Leu Ser Val Lys Leu Gly Asp Ser Val Val  
Phe Asp Ala Ser Gly Ser Thr Asp Asp Val Gly Val Thr Gly Tyr Ser Trp Ser Thr Gly Gly Ser Ala  
Lys Thr Glu Thr Val Leu Phe Asp Ala Leu Gly Thr Lys Thr Ile Thr Val Thr Val Ala Asp Ala Asp  
Gly Leu Thr Ser Lys Ala Ser Ala Thr Val Thr Val Thr Asp Gly Ser Val Ala Tyr Asn Ser Asn Phe  
Ala Ser Leu Asn Phe Arg Gly Thr Pro Asn Ser Trp Gly Ala Ala Ala Met Thr Leu Val Ala Asp Asn  
Thr Trp Glu Ala Thr Val Asn Phe Asp Gly Gln Ala Asn Gln Arg Phe Lys Phe Asp Ile Lys Gly Asp  
Trp Ser Gln Asn Tyr Gly Asp Ser Asn Lys Asp Gly Val Ala Glu Arg Thr Gly Ala Asp Ile Tyr Thr  
Thr Val Thr Gly Gln Tyr Lys Val Gln Phe Asn Asp Ser Thr Leu Lys Tyr Thr Leu Thr Lys Leu Ala  
Asp Ser Ser Ala Thr Ser Tyr Ser Ala Asn Phe Ala Ser Leu Tyr Leu Arg Gly Thr Pro Asn Ser Trp  
Gly Thr Thr Ala Met Lys Leu Val Ala Asn Asn Ser Trp Gln Ala Glu Val Thr Phe Thr Gly Lys Gly  
Asp Ala Thr Gly Ala Gln Arg Phe Lys Phe Asp Val Lys Gly Asp Trp Ser Gln Asn Tyr Gly Asp Ser  
Asn Met Asp Gly Thr Ala Glu Arg Thr Gly Gly Asp Ile Thr Ser Ala Val Val Gly Thr Tyr Leu Val  
Thr Phe Asn Asp Ser Thr Leu Lys Tyr Thr Leu Thr Ala Lys

SEQ ID NO: 205

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gactaaagaatcaggaaaactccgcaattttatgggagcgatatcaaggcatcacccaaaaataatgaggggtattttagtaaaactaggc  
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aacaattaccggttaattggtgttttgatgacggtaacaaaactgtagatgcctattcaggcaagaacccagttaaaaatggtatcgtttcacttt  
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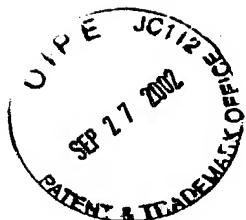


Figure 16JJJJ

SEQ ID NO: 206

Met Tyr Arg Val Ile Pro Ile Ile Leu Ile Met Ser Met Ile Val Ala Cys Glu Ser Pro Lys Lys Lys Thr  
Thr Glu Thr Ala Gln Pro Ser Thr Asn Ala Glu Lys Pro Phe Val Trp Glu Ala Ala Asn Val Tyr Phe  
Leu Leu Thr Asp Arg Phe Asn Asn Gly Asn Pro Asn Asn Asp Ile Asn Phe Asn Arg Thr Lys Glu  
Ser Gly Lys Leu Arg Asn Phe Met Gly Gly Asp Ile Lys Gly Ile Thr Gln Lys Ile Asn Glu Gly Tyr  
Phe Ser Lys Leu Gly Val Asn Ala Ile Trp Leu Thr Pro Val Val Glu Gln Ile His Gly Ser Val Asp  
Glu Gly Thr Gly Asn Thr Tyr Ala Phe His Gly Tyr Trp Ala Lys Asp Trp Thr Asn Leu Asp Pro Asn  
Phe Gly Thr Lys Glu Asp Leu Ala Glu Leu Val Ala Thr Ala His Ala Lys Gly Ile Arg Ile Leu Leu  
Asp Val Val Ile Asn His Thr Gly Pro Val Thr Asp Gln Asp Pro Val Trp Gly Glu Asp Trp Val Arg  
Thr Gly Pro Gln Cys Thr Tyr Asp Asn Tyr Thr Asn Thr Thr Ser Cys Thr Leu Val Ala Asn Leu Pro  
Asp Ile Leu Thr Glu Ser Asn Glu Asn Val Ala Leu Pro Thr Phe Leu Leu Asp Lys Trp Lys Ala Glu  
Gly Arg Leu Glu Gln Glu Leu Lys Glu Leu Asp Asp Phe Phe Ser Arg Thr Gly His Pro Arg Ala Pro  
Arg Phe Tyr Ile Ile Lys Trp Leu Thr Asp Tyr Ile Arg Glu Phe Gly Val Asp Gly Phe Arg Val Asp  
Thr Val Lys His Thr Glu Glu Thr Val Trp Ala Glu Leu Tyr Asp Glu Ala Val Ile Ala Phe Ala Glu  
Tyr Lys Lys Ala Asn Pro Asp Lys Val Leu Asp Asp Asn Glu Phe Tyr Met Val Gly Glu Val Tyr  
Asn Tyr Gly Ile Ser Gly Gly Arg Phe Tyr Asp Phe Gly Asp Lys Lys Val Asp Tyr Phe Asp His Gly  
Phe Lys Ser Leu Ile Asn Phe Glu Met Lys Tyr Asp Ala Asn Phe Thr Tyr Asp Thr Leu Phe Arg Lys  
Tyr Asp Thr Leu Leu His Thr Lys Leu Lys Gly Arg Ser Val Leu Asn Tyr Leu Ser Ser His Asp Asp  
Gly Ser Pro Phe Asp Lys Met Arg Gln Lys Pro Tyr Glu Ser Ala Thr Lys Leu Leu Leu Thr Pro Gly  
Ala Ser Gln Ile Tyr Tyr Gly Asp Glu Thr Ala Arg Ser Leu Asn Ile Glu Gly Ala Gln Gly Asp Ala  
Thr Leu Arg Ser Phe Met Asn Trp Glu Glu Leu Ala Glu Asp Pro Ala Lys Gln Lys Ile Leu Gln His  
Trp Gln Lys Leu Gly Ser Phe Arg Asn Asn His Pro Ala Val Gly Ala Gly Arg His Lys Thr Leu Gly  
Lys Lys Pro Phe Tyr Thr Phe Ser Arg Val Tyr Gln Lys Asn Gly Phe Ile Asp Lys Val Val Val Ala  
Leu Asp Ala Pro Lys Gly Gln Lys Gln Ile Thr Val Asn Gly Val Phe Asp Asp Gly Thr Lys Leu Val  
Asp Ala Tyr Ser Gly Lys Glu Thr Ser Val Lys Asn Gly Ile Val Ser Leu Ser Ser Glu Phe Asp Ile  
Val Leu Leu Glu Gln Lys

SEQ ID NO: 207

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cggtgtcgtggtttgcaacgaaggttacggcctaaacgggtcgcggctgacactgtgccccgttcttgaggccctcgacgagtgccggaa  
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aaagcgccagggcatcaacggcgatgtccttaggttagggcggtagctctcatcgtcgcgccagagccagtgctggtccagctcttctcgtg  
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cctcgtaacctcggtatcttgcctgatggtgtccaccagattcctccacctgggagctccagtagaaggcctgcattataacgccgcct  
ctccagctcggagtacttggccataagttacctctactagattaaaa

SEQ ID NO: 208

Leu Ser Thr Glu Pro Phe Val Leu Gly Ser Arg Leu Thr Leu Ser Pro Pro Arg Ser Ser Ser Arg Arg  
Ser Ser Arg Asn Ser Arg Trp Pro Gly Arg Gly Gln Gly Pro Arg Gly Thr Pro Thr Arg Leu Ser Pro  
Pro Thr Cys Pro Pro Ser Arg Arg Gly Cys Arg Cys Thr Arg Gly Cys Thr Leu Pro Arg Thr Ser Glu  
Arg Arg Pro Thr Phe Arg Leu Cys Leu Arg Arg Gly Cys Met Leu Ser Val Pro Ala Cys Phe Arg

Figure 16KKKK



Applicant(s): Walter Callen et al.  
ENZYMES HAVING ALPHA AMYLASE ACTIVITY AND  
METHODS OF USE THEREOF

Ser Arg Phe Ser Arg Ile Ser Ala Arg Arg Cys Arg Ser Lys Arg Arg Gln Cys Phe Leu Arg Pro Gly  
Cys His Val Ser Arg Gly Ser Ala Tyr Pro Cys Ala Thr Pro Arg Ser Arg Gly Arg Ile Leu Ser Ala  
Gly Pro Arg Arg Gly Thr Arg Arg Leu Asp Thr Cys Ser Arg Leu Tyr Arg Cys Arg Gly Leu Gln  
Arg Arg Leu Arg Pro Thr Gly Arg Gly Arg Leu Cys Pro Arg Ser Gly Pro Arg Arg Val Arg Glu  
Cys Ser Cys Cys Gln Arg Pro Arg Pro Ser Cys Ser Arg Ala Gly Ser Arg Arg Pro Trp Arg Arg Ser  
Ser Arg Pro Ser Gly Val His Gln Arg Trp Cys Pro Ser Thr Arg Gln Arg Pro Ser Arg Pro Thr Ser  
Ala Ser Pro Arg Pro Thr Leu Arg Gly Pro Ser Arg Ser Gln Ser Ala Arg His Gln Arg Arg Cys Ser  
Leu Gly Arg Arg Arg Ser Ser His Arg Ser Pro Arg Ala Ser Ala Gly Pro Ser Ser Ser Arg Gly Leu  
Cys Leu Gly Ser Leu Gln Met Cys Pro Arg His Ser Thr Pro Arg Trp Gly Gly Ser Arg Gly Ser Trp  
Gln Tyr Ile Cys Pro Arg Pro Pro Leu Arg Ser Pro Ser Arg Cys Ser Pro Gln Arg Thr Gly Ser Thr  
Arg Gly Leu Arg Leu Arg Gly Gly Leu Arg Cys Pro Leu Pro Leu Cys Arg Arg His Gly Pro Cys  
Leu Ser Cys Ser Arg Ala Pro Ala Trp Ser Gln Ser Ala Ser Leu Pro Phe Pro Ser Gly Arg Thr His  
Arg Gly Gln Arg Ser Arg Arg Gly Arg Ser Pro Ser Asn Arg Arg Arg Pro Cys Pro Cys Ser Pro Gly  
Glu Ser Lys Trp Arg Ile Phe Pro Pro Arg Thr Thr Pro Val Ser Cys Ser Trp Cys Pro Thr Arg Phe  
Leu His Leu Gly Arg Pro Ser Arg Arg Pro Ala Leu Arg Arg Pro Leu Pro Ala Arg Ser Thr Trp Pro  
Val Thr Ser Tyr Ile Lys

## SEQ ID NO: 209

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atgtcacctgcattgcttcaactggagctatgccgatgtcgtgatcgccggttgacatcgctgcagcagggtacagtgccgtgctggtggccc  
cgccacttcgatccgaagcacggcctggtggcgcgataccagccccaggatctccgccttatcgaccatccgctgggcaatacacatgacttc  
gtcaacatgatgatgctctgatgatgtgggtgtggcggtgtacgccgacatcgtgtcaaccacatggccaatgaggctgcacaaaggcctga  
cctgaactaccctggtcaggcagtgcttgacgaatatgctccgatcccggtcatttcgagggcttgaggctgttcggtaattcgacttcaatttct  
gtcggacatgatttcggaccgccccagtgatgcattcaggattacagcgatgtgttcagggtccagaactggcggtgtgctggaccgcccgccgacc  
cgggctgccccgacctggtcgccaatgactgggtgatctcacaagcgccagtatctggaagccatcaaggcgctgggtgtgctggcatcg  
catcgacgggtcaagcatatgcccatgagccatataatgccgttctcaccgccgagatccggctgggctgcatgtgttgccgaagtcacacc  
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atcacgcagatattccgaacaatgacggatttcgctaccagatactgaccccgatgaatcactggcctacgcctacattctggccgcgatg  
gcggtgtcccgttctgtattccgacaacaatgaaagcgcgatggccgctggatcgtgctggcaacgtccggatctggttgcaatggtcggt  
tccacaatgcagtcacggcagcatggcgtgcttcacatgacgactgccacctgctgttcggcgcgccagcctcggtgattgctggcatca  
acaagtgcggccatgcactcagctcctgggtcaacatgaaccagagcgtactgtggtgtacgcggactacacagacgtgctcgacagcaacag  
cgtgtcaacatccagtcacctggcacgagttcatccttcccgcccgccaggcacgcctgtggttgcca

## SEQ ID NO: 210

MIQPMHSREQACRLIPALIMTFALALPLQIRADVTLHAFNWSYADVADRAVDIAAAGYSA  
VLVAPPLRSEGTAWWARYQPQDLRLIDHPLGNTHDFVNMIDALDDVGVGVYADIVLNHM  
ANEAARPDNLNYPGQAVLDEYASDPGHFEGLRLFGNLSFNFLSEHDFGPAQCIQDYSDF  
QVQNWRLCGPPDPGLPDLVANDWVISQQRQYLEAIKALGVAGMRIDAVKHMPSHINA  
VLTPEIRSLGHVFGEVITSGGAGDTSYDRFLAPYLAQSDHGAYDFPLFETIRRAFGFSGSMS  
ELVDPAAYGQALPPDRAITFVITHIPNNDGFRYQILDVPDESLEYAYILGRDGGVPLLYSD  
NNESGDGRWIDAWQRPDLVAMVGFHNAVHGDMAVLSHDDCHLLFRGSLGIVGINKC  
GHALSSWVNMNQSIVLWWYADYTDVLDNSVNIQSSWHEFILPARQARLWLR

## SEQ ID NO: 211

GTGTTTCGTTCTGACACAGTTTCGCGTACCTGCATGTATGGTGCGCTGCGTAATGCCTA  
CCAACCCGATCGGGTGTCTTACTGGAGTCACGGTGCGGACATGCAACTTAAAAAAGCAT  
GCTCATCGCCAGGCGCTGTTGTTTCATCGTGACGCGGTGCTGTGCCTGAAATCCAGGC  
AGACCCATAAAAAACAACAACAAACCGATAACAAACGACCCAAGCCTTCTAAGAGGAG  
AAAACGGGATGGCTTTTAAACTACGAAAAAGGCGCTCGTTGGCCTGTTACGGCCGG

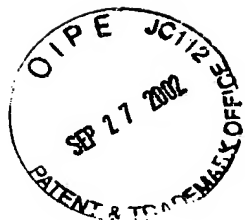


Figure 16LLLL

CGCAATGGTATATGCCGGTGCAGCGGCGAGTGGTGAAATCATTCTGCAGGGCTTCCAC  
TGGCACTCCAAGTGGGGCGGCAACAATCAGGGTTGGTGGCAGGTGATGGAAGGTCAG  
GCCAACACCATCGCCAACGCCGGCTTTACGCACGTGTGGTTCCCGCCGGTCCATAACT  
CGGCCGATGCCGAGGGTTACCTACCCCGCGAGCTGAACAACCTCAACTCCAGCTATGG  
CTCCGAAGCACAGCTGCGCAGCGCCATCCAGGCACTGAACAATCGCGGCGTGCATGCG  
ATTGCCGATGTGGTCATGAACCACCGGGTGGGCTGCTCTGGCTGGGCGGATTTCTGTA  
ACCCGGACTGGCCGACCTGGTACATCGTCGCCAATGATTCCTGGCCCCGGTGGCCCCGAA  
AAGCCAGAACTGGGACACGGGTGAGACGTACCACGCCGCCCGTGACCTCGATCACGC  
CAATCCGCAGGTGCGCAACGATATCTCGCACTACCTGAACAGCCGCCTCAAGGACGTC  
GGCTTCTCCGGCTGGCGCTGGGACTATGCCAAGGGTTTCTGGCCCCGGCTATGTCGGCG  
AGTACAACTGGAACACCAACCCGAACTTCTGTGTGGGTGAGGTGTGGGACGATCTCGA  
CCCCAACAATCCCAACCCGCAACCGCCAGCAACTGGTGGACTGGGTGATGCTACCGGT  
GGCAGTTGTACGTCCTTCGACTTCACCACCAAGGGGCTGACGAACTATGCGCTGCAGC  
ATGGCCAGTACTGGCGCCTGCAGGGTGATAATGGTGGCCCCGGCTGGCGGCATCGGCTG  
GTGGCCGCAACGCATGGTGACCTTCGTCGACAACCATGACACGGGCCCCGAGCAATCAC  
TGTGGTGACGGCCAGAACCTCTGGCCCCGTGCCCTGTGACAAGGTCATGGAGGCGTATG  
CCTACATCCTGACCCATCCGGGCGTGCCGTGCGGTGTACTGGACGCACTTCTTCAACTGG  
AATCTTGGTAGCGAGATCAGCCAGTTGATGCAGATCCGCAAGAACCAGGGCGTGCAC  
CCGGTTCGACGTCTGGATCGCCGAGGCCCCGTACGGCCTGTACGCCGCTATATCAA  
CGGTAATGTGGCGATGAAGATGGGCTGGGATAACTGGAGCCCCGGGCTGGGGCTGGTC  
GCTGGCGGCCCTCCGGTAACAACCTGGGCCGTCTGGACACGCTGA

SEQ ID NO: 212

VFRSDTVSRTCMYGALRNAYQPDRVFTGVTVRTCNLKKHAHRQALLFIVTRCLCLKSRQT  
HKNNNKPITNDPSLLRGENGMAFKLRKKALVGLFTAGAMVYAGAAAASGEIILQGFHWHS  
KWGGNNQGWVQVMQANTIANAGFTHVWFPPVHNSADAEGYLPRELNNLNSSYGSEA  
QLRSAIQALNNRGVHAIADVMMNHRVGC SGWADFCNPDWPTWYIVANDSWPGGPKSQN  
WDTGETYHAARDLDHANPQVRNDISHYLSRLKDVGFSGWRWDYAKGFWPGYVGEYN  
WNTNPNFCVGEVWDDLDPNPNPNPHRQQLVDWVDATGGSCHVDFDFTTKGLTNYALQHGO  
YWRLQGDNGGPAGGIGWWPQRMVTFVDNHD TGPSNHCGDGQNLWPVPCDKVMEAYA  
YILTHPGVPSVYWTHFFNWNLGSEISQLMQIRKNQGVHSGSDVWIAEARHGLYAAAYINGN  
VAMKMGWDNWSPGWGWSLAASGNNWAVWTR

**Figure 16MMMM**